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JØRGENSEN (J.). **Coloradobillen. En samlet oversigt.** [The Colorado Beetle. A collective Review.]—64 pp., 28 figs., 26 refs. Copenhagen, St. Plantetilsyn, 1958.

The author describes all stages and the bionomics of *Leptinotarsa decemlineata* (Say), reviews its food-plants, natural enemies and distribution on potato in Europe [*cf. R.A.E.*, A **47** 355, etc.] and summarises the usual methods of control. The beetle has been found every year since 1949 at places in southern Denmark, but the control measures applied have prevented it from becoming established in that country [*cf. loc. cit.*]. In laboratory observations on its bionomics there, winter mortality was high, overwintering adults were present from mid-April to mid-June, eggs were laid in June–July and sometimes in August, egg viability was often low, the larvae hatched in about 12 days and became full-fed in about 10–15 days at favourable temperatures but required a month or more under cool conditions, and first-generation adults emerged in August–September, fed for about three weeks and overwintered without reproducing.

POLACEK (K.). **Report to the Government of Cyprus on the Fumigation of *Citrus* Fruit and other Foodstuffs.**—*FAO Rep.* no. 978, [3 + ] 10 pp., multigraph. Rome, 1958.

*Citrus* fruits exported from Cyprus to many countries have to be free from infestation by *Ceratitis capitata* (Wied.). With a view to the institution of effective control by means of fumigation, the author visited Cyprus from 1st November 1957 to 30th April 1958 and studied local conditions and facilities. His findings are described in this report.

It was found that all stages of *C. capitata* in the fruits were killed by fumigation with ethylene dibromide at 8 oz. per 1,000 cu. ft. for 120 minutes at 17°C. [62·6°F.], and that this rate was well within the limits of tolerance of the fruits. A method of measuring gas concentrations in the chamber during fumigation by means of *Drosophila* was developed, and a laboratory strain of these flies established. Recommendations for suitable fumigation chambers and the training of operators are made.

Fumigation treatments for the control of *Gnorimoschema operculella* (Zell.) on stored potatoes and of stored grain against various insects, notably *Trogoderma granarium* Everts, one of the principal grain pests in the island, were also considered. Fumigation with methyl bromide at 30 oz. per 1,000 cu. ft. for three hours at 14–20°C. [57·2–68°F.] is effective against *G. operculella*, but as methyl bromide has no odour and as fumigation facilities are insufficient and treatment would have to be carried out by operators not familiar with this fumigant, it is suggested that a 4:1 mixture of methyl bromide and ethylene dibromide, which has a distinctive odour, should be used. A method of applying the two gases concurrently is described. Stored grain should be fumigated with aluminium-phosphide tablets (Phostoxin) [*cf. R.A.E.*, A **47** 307, etc.] under tarpaulins, but treatment would be simplified by the construction of metal silos. Walls and ceilings should first be sprayed with DDT.

SCHMITZ (G.). **Quelques observations effectuées dans le nord du Congo belge sur les épicampoptères ennemis des caféiers.**—*Bull. INEAC* **7** no. 4 pp. 261–266, 5 figs. Brussels, 1958.

Three of the species of *Epicampoptera* found in the Belgian Congo, *E. andersoni* (Tams), *E. strandi* Bryk (*marantica* (Tams)) and *E. vulvornata* Her., attack robusta coffee. The first is mostly restricted to the mountainous region of the eastern Congo but is found also on arabica coffee in the eastern part of the upper Uele. The other two occur in all the lower-altitude regions of the central basin where robusta coffee is grown and where the dry season does not exceed three months. The larvae feed on the leaves and can defoliate a tree in 5–6 days. The fruits are left, but some fall before they are ripe. A 100-acre plantation near Zobia was completely defoliated in 1952 and was again attacked in 1957. At the end of 1956, a plantation in Buta territory suffered a combined attack by larvae of *Epicampoptera* and *Dichocrocis crocodora* (Meyr.), but the former were not numerous and were effectively controlled by DDT and lead arsenate. The first serious attacks by *Epicampoptera* occurred in March and April 1957 in the Ubangi region and later in the year in the Uele region, about 375 and 500 acres, respectively, suffering serious damage. *E. strandi* was the chief pest in Uele and *E. vulvornata* in Ubangi. The two species can be differentiated by the grouping of the eggs and the appearance of the larvae.

All stages of *Epicampoptera* spp. are briefly described. The life-cycle is completed in 37–44 days, the egg, larval and pupal stages and the pre-oviposition period lasting 4–6, 22–25, 9–10 and 2–3 days, respectively, and there are several overlapping generations a year.

Endrin, used on coffee in the Uele district to control *Stephanoderes hampei* (Ferr.) is ineffective against *Epicampoptera* spp. except in the early larval instars, and may even favour infestation by killing parasites and predators. The author recommends dusts or sprays of lead arsenate or DDT for control. Only one application is necessary, as their effectiveness lasts for about 20 days.

ASENJO (C. F.), MARÍN (L. A.), TORRES (W.) & DEL CAMPILLO (A.). **Termite-repellent Activity and chemical Composition of West Indian Mahogany Wood (*Swietenia mahagoni* Jacq.), with special Reference to the $P_2$ Fraction.**—*J. Agric. Univ. P.R.* **42** no. 3 pp. 185–195, 2 figs., 7 refs. Río Piedras, P.R., 1958. (With a Summary in Spanish.)

West Indian mahogany (*Swietenia mahagoni*) is very resistant to attack by *Cryptotermes brevis* (Wlk.), and the senior author isolated from this wood in 1951 a crude waxy-white substance that was strongly repellent to termites when tested by a biological method. An account is given of further tests with substances obtained from the wood by serial extraction with selective solvents, in which standard blocks of *Poinciana* (*Delonix*) *regia* that had been immersed for ten minutes in solutions of the substances were, when dry, exposed to *C. brevis* in petri dishes. The following is substantially the authors' summary of the results. A petroleum-ether extract was the only fraction to exhibit promising termite-repellent activity, and mahogany blocks subjected to petroleum-ether extraction became susceptible to termite attack. A waxy substance ($P_2$ fraction) separated from the petroleum-ether extract at times showed high termite-repellent activity. The termite-repellent principle in the $P_2$ fraction seemed to be a labile one, as effectiveness varied greatly from batch to batch. The $P_2$ fraction is a mixture of two major components and of at least a third minor one. As far as could be determined, this mixture, at the elemental level, contains only carbon, hydrogen and oxygen, while esters were the only compounds definitely characterised at the structural level.

KEIFER (H. H.). **Eriophyid Studies XXVII.**—*Occ. Pap. Bur. Ent. Calif. Dep. Agric.* no. 1, 18 pp., 12 figs., multigraph. Sacramento, Cal., 1959.

Five new genera and ten new species of Eriophyids are described. The new genera include *Aculus*, which is erected for certain species heretofore placed in *Vasates*. The type is *A.* (*V.*) *ligustri* (Keifer) (the privet rust mite), and the other species transferred to it comprise *A.* (*V.*) *cornutus* (Banks) (the peach silver mite), *A.* (*V.*) *eurynotus* (Nal.) (the celery mite), *A.* (*V.*) *fockeui* (Nal. & Trt.) (the plum nursery mite), *A.* (*V.*) *malivagrans* (Keifer) (the apple rust mite), which is possibly a synonym of *A.* (*V.*) *schlechtendali* (Nal.) [*cf. R.A.E.*, A **36** 83], *A.* (*V.*) *rhododendronis* (Keifer) (the azalea rust mite), *A.* (*V.*) *symphoricarpi* (Keifer) (the snow berry rust mite), *A.* (*V.*) *tamalpais* (Keifer) (the native filbert rust mite) and *A.* (*V.*) *wagnoni* (Keifer) (the Sierra plum rust mite), all of which occur in California, and *A.* (*V.*) *lycopersici* (Massee) (the tomato russet mite). Characters differentiating *Phyllocoptes*, *Vasates*, which is redescribed, and *Aculus* are given. The new species include *Aceria georghioui*, on carnation in Cyprus, *Tegonotus hassani*, on olive in Egypt, and *Aculus pelekassi*, on *Citrus* in Greece, *Catarhinus* (gen. n.) *tricholaenae*, on Natal grass (*Tricholaena rosea*) and maize in Brazil, and *Diptacus swensoni*, on holly (*Ilex aquifolium*) in Oregon. A key to the genera of the Rhyncaphytoptinae is appended.

PARAMESWARAN PILLAI (P. R.). **Pests of stored Fish and Prawns.**—*Bull. Res. Inst. Univ. Kerala* (C) **5** no. 3 [2+] 79 pp., 2 pls., 15 figs., 8 fldg. tables, 6½ pp. refs. Trivandrum, 1957.

Most of the fish caught in Kerala State, in southern India, is cured for local markets or for export. Fish that is both sun-dried and salt-cured remains free from attack by pests, but anchovies, sardines and also prawns are sun-dried only, and these and other fish not salt-cured become heavily infested; lack of cleanliness in storage, inadequate drying and unsatisfactory packing materials intensify the damage.

A list is given of eight insects and five mites found in dried fish or prawns in the State, with information on their synonymy, distribution and habits, and, for the mites, the morphology of the adults of both sexes. *Dermestes ater* Deg. was the most injurious of the insects [*cf. R.A.E.*, A **44** 423], especially to dried anchovies and prawns, and *Lardoglyphus konoi* (Sasa & Asanuma), which causes severe damage to dried prawns, was the only mite that reached pest numbers. *Necrobia rufipes* (Deg.) occasionally injured fish or prawns as larvae and preyed on examples of its own species or of *D. ater* as adults, and *Cheyletus munroi* var. *bituberculatus*, n., was predacious on *L. konoi*. Detailed accounts are given of observations on the bionomics of all of these. Most of the other pests were of limited occurrence, but *D. maculatus* Deg. was found infesting dried shark fins, *Suidasia medanensis* Oudm. (a mite) was occasionally numerous on dried anchovies, and a Glycyphagid described as *Glycycometus travancoricus*, gen. et sp.n., fed on it and, in its absence, on the dried product.

Dried prawns are prepared by parboiling, drying in the sun and threshing, and tests showed that the addition of salt at 2·5 and 5 per cent. to the water in which they were boiled protected them from infestation by *L. konoi* for 45 and 56 days, respectively, without materially affecting the flavour, whereas higher concentrations, though giving longer protection, spoilt it. Sprinkling the dried prawns with 1·5 per cent. pepper protected them for seven weeks, but was too expensive for general use. Packing in gunny bags lined with polyethylene bonded with bitumen permitted slight invasion by the mite through the stitches by which they were closed, and packing in airtight polyethylene bags inside gunny bags gave complete protection for three months, but led to excessive mould development. Paper linings to gunny bags gave similar results and cost less, but all linings are of doubtful value in practice, as they are easily torn.

Hygienic storage of the dried products in warehouses is recommended. Walls and floors should be smooth, and filled bags should be kept out of contact with them. Walls and ceilings should be treated with DDT, though this insecticide is not effective against *D. ater*, and liberal use made of pyrethrum dusts and sprays. Fumigation of bundles of empty bags under a tarpaulin, with the fumigant introduced from the top and a fan operated at intervals of eight hours to improve gas circulation, was also tested. Methyl bromide at 2 lb. per 1,000 cu. ft. killed the pests in 24 hours, and ethylene dibromide at 4 lb. per 1,000 cu. ft. for 72 hours and a mixture of ethylene dichloride and carbon tetrachloride at 20 lb. per 1,000 cu. ft. for 48 hours also gave good results. The first is too dangerous for use without expert supervision, and ethylene dibromide is not as safe as the mixture.

FERNANDO (H. E.) & PEIRIS (J. W. L.). **Investigations on the Chilli Leaf Curl Complex and its Control.**—*Trop. Agriculturist* **113** no. 4 pp. 305–323, 3 figs., 23 refs. Peradeniya, 1957.

Leaf-curling of chilli [*Capsicum frutescens*] occurs widely in Ceylon, especially in the Jaffna peninsula, and is due to feeding by a thrips [*cf. R.A.E.*, A **27** 494] and a mite [**33** 299] recently identified as *Scirtothrips dorsalis* Hood and *Hemitarsonemus latus* (Banks), respectively, and to virus disease. The viruses concerned are the vein-clearing, the leaf-mottle and the tobacco-mosaic viruses, but a little-leaf disease of possible virus origin also occurs, and *C. annuum* suffers from a mosaic that is also probably caused by a virus. As a survey had shown that *Aphis gossypii* Glov., *Bemisia tabaci* (Gennadius) (*inconspicua* (Quaint.)), *S. dorsalis* and *H. latus* were common on chilli, these were all tested for their ability to transmit the leaf-mottle, and vein-clearing viruses. *A. gossypii* was the only one to transmit leaf-mottle, and *B. tabaci* the only one to transmit vein-clearing, of which it was an efficient vector. This Aleyrodid was subsequently used to determine further hosts of the vein-clearing virus and transmitted it to tomato and tobacco but not brinjal [*Solanum melongena*]. Other plants, particularly two common weeds of chilli plantings, *Ageratum conyzoides* and *Gynura crepidioides*, probably serve as symptomless hosts of this virus, but their importance was not known, as it was impossible to establish a virus-free strain of *B. tabaci*. In a preliminary examination of varietal resistance to the vein-clearing virus, 60–70 per cent. of seedlings of six varieties of chilli developed leaf-curl within 12–15 days of feeding by *B. tabaci*.

The effect of insecticides on the pests, and thus indirectly on the control of leaf-curl, was investigated in three groups of tests. In the first, carried out at Peradeniya, seven weekly applications of a 25 per cent. DDT emulsion concentrate at 3·5 fl. oz. per gal., 50 per cent. wettable sulphur at 1 oz. per 1·25 gal. and a 46 per cent. toxaphene emulsion concentrate at 20 cc. per gal. gave complete control of *H. latus*. The same materials, and also 40 per cent. wettable toxaphene at 22 g. per gal. and 2 per cent. BHC dust with an equal amount of sulphur, were effective against *A. gossypii*, but the incidence of leaf-curl was reduced only by the dust mixture of BHC and sulphur and one of 5 per cent. DDT with sulphur, which reduced the average percentage of infection to 16 and 18·7, respectively, as compared with 47·4 for untreated plants. The second series, carried out at Jaffna, was not concluded, but the evidence indicated that emulsion sprays of DDT or toxaphene and a spray of wettable sulphur were of value in the control of leaf-curl caused by *H. latus* and *Scirtothrips dorsalis* when applied at intervals of two or four weeks. In the final series, parathion, diazinon [O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl phosphorothioate], malathion and DDT with sulphur were tested as foliar sprays, and Metasystox [dimethyl 2-(ethylthio)ethyl phosphorothioate (methyl-demeton)] and Ekatin [O,O-dimethyl S-2-(ethylthio)ethyl phosphorodithioate (thiometon)] as systemic root applications. Populations of *S. dorsalis* were greatly reduced by all the insecticides, but *H. latus* was unaffected and none of the virus conditions appeared to be alleviated, whilst yellowing of the leaves was consistently present. It is concluded that recommendations for the control of chilli leaf-curl should include rotation of crops, clean cultivation and the use of insecticides, but that the development of resistant varieties offers most hope for the future.

FERNANDO (H. E.) & MANICKAVASAGAR (P.). **Investigations on the Control of the Paddy Stem Fly** *Atherigona* **sp. (Fam. Anthomyiidae Ord. Diptera).**—*Trop. Agriculturist* **113** no. 4 pp. 341–345, 3 refs. Peradeniya, 1957.

An unidentified species of *Atherigona* infests seedling rice in Ceylon, especially in highland nurseries. The eggs are laid singly on the leaf blades of seedlings up to 2–3 weeks old; the larvae hatch in two days and bore in the stem, the tissues of which turn brown and rot as the larvae approach the base. The larval and pupal stages each last about a week, pupation occurring either within or outside the stem. Rice is infested after prolonged periods of drought or faulty irrigation, and at other times the Anthomyiid lives on wild grasses. Earlier measures recommended for control were largely ineffective, and phosphorus insecticides were therefore tested in emulsion sprays in 1956–57. The seedlings were three weeks old, the plots were 320 sq. ft. in area and separated by barrier plots from one another, and the sprays were applied at about 60 gal. per acre. Infestation was heavy, and plants were examined for larval mortality 24, 48 and 72 hours after treatment. The results showed that 100 per cent. kill was given in 24 hours by Ekatin [O,O-dimethyl S-2-(ethylthio)ethyl phosphorodithioate (thiometon)] at 0·0039 per cent. and by parathion at 0·0062 per cent., and in 48 hours by Gusathion [O,O-dimethyl S-(4-oxo-benzotriazino-3-methyl) phosphorodithioate] at 0·0039 per cent. and Dipterex [dimethyl 2,2,2-trichloro-1-hydroxyethylphosphonate] at 0·006 per cent. Malathion and diazinon [O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl phosphorothioate] were relatively ineffective at 0·039 and 0·024 per cent., respectively, although the latter gave 80 per cent. mortality in 48 hours, and poor results were given by Metasystox [dimethyl 2-(ethylthio)ethyl phosphorothioate (methyl-demeton)] and two other materials. Sprays should be applied at the first sign of withering of the central shoot, so that the larvae are destroyed before the plant has lost its tillering ability.

JUDENKO (E.). **Some Observations on the Behaviour of the Adult Shot-hole Borer** (*Xyleborus fornicatus* **Eich.) under Laboratory Conditions.** —*Tea Quart.* **29** pt. 1 pp. 47–50, 4 refs. Talawakelle, 1958.

As a knowledge of the behaviour of the adults of *Xyleborus fornicatus* Eichh. outside their galleries is important in considering the use of contact insecticides for their control on tea in Ceylon, investigations were carried out in the laboratory with tea bushes planted in barrels. The bushes were artificially infested in October–November 1956, and adult emergence occurred from 4th January to 9th February 1957. Of the 33 live adults seen, 29 were females, and daily observations showed that some of these ultimately entered old galleries, some made new ones and others flew away or died. Some adults of both sexes dropped or crawled to the soil surface under windless conditions, and some burrowed into the soil. Most of them spent some time crawling on the plants at a height of not more than 1 ft.

JUDENKO (E.). **Trials with a Method of Assessment of Infestation caused by Shot-hole Borer** (*Xyleborus fornicatus* **Eich.**) **on old Tea.**—*Tea Quart.* **29** pt. 1 pp. 51–59, 1 fldg. table, 10 refs. Talawakelle, 1958.

Investigations leading to the selection of a standard sampling unit for studies of the population density of *Xyleborus fornicatus* Eichh. on tea in Ceylon [*R.A.E.*, A **46** 113] are described, and it is stated that observations in 30 fields showed that infestation was light below 1,000 ft. elevation, heavy at 2,000–3,000 ft. (and in the only field examined between 3,000 and 4,000 ft.) and light or absent above 4,000 ft. The standard unit might be suitable for assessing the degree of infestation in field experiments at intervals between pruning, but the method needs further investigation.

MA (Shih-chun). **The Population Dynamics of the Oriental Migratory Locust** (*Locusta migratoria manilensis* **Meyen**) **in China.** [*In Chinese.*] —*Acta ent. sin.* **8** no. 1 pp. 1–40, 28 figs., 62 refs. [Peking] 1958. (With a Summary in English.)

Observations on factors affecting the abundance of *Locusta migratoria manilensis* (Meyen) in China were made in 1952–56 and were supplemented by a study of the older literature of that country; graphs are given illustrating the fluctuations in locust population for each decade from A.D. 960. The numbers of years between outbreaks varied in general from four to 15, but were mostly 9–11 between 1906 and 1956. The total number of outbreaks over the whole period varied with locality, the maximum being 236 in the basin of the Hwai-ho, and 75 per cent. of the total lasted only one year. Drought in the same year was associated with 45 per cent. of the outbreaks, and drought in the preceding year with 33 per cent.; 54 per cent. of them occurred two years and 26 per cent. one year after floods. Topography was important in the formation of outbreak centres, chiefly through the action of ground water on the eggs. There was only weak correlation of outbreaks with sunspot numbers. The population cycle of two fluctuations every ten years or five in every 20 years corresponded roughly with periodical variations in climate in some localities.

In 1952–56, the annual mortality of eggs, nymphs and adults due to unfavourable weather ranged from less than 1 to over 15 per cent., with a maximum of 42 per cent. Natural enemies accounted for only 4·7–15·16 per cent. mortality. A population growth coefficient was calculated, based on maturity, growth rate and fecundity. In tests with various plants as food, the coefficients were highest on *Miscanthus saccharifer* (*sacchariflorus*) (91·96), *Cynodon dactylon* (95·02) and sorghum (121·31); the theoretical value obtained under laboratory conditions was 237·6.

The rate of development of the locust was dependent on temperature, and there was no true diapause. The number of generations a year was variable and ranged from 3–4 in the south (25°N.lat.) to 1–2 in the north (40°N.lat.), and the time required for the population to increase to outbreak proportions varied likewise from 1 to 1·5–2 years. The maximum number of eggs per female was 721 (in 12 egg-pods), but the usual number was 240–360. Temperature sums for the development of the various stages are given.

Lin (Ch'ang-shan) & Cheng (Cheng-liang). **Testing the Number of Generations of the Army Worm** (*Cirphis unipuncta* **Haw.) occurring in various geographical Regions in China by the Method of "Thermal Sums".** [*In Chinese.*]—*Acta ent. sin.* **8** no. 1 pp. 41–56, 1 graph, 1 fldg. map, 41 refs. [Peking] 1958. (With a Summary in English.)

*Pseudaletia* (*Cirphis*) *unipuncta* (Haw.) occurs throughout China, but the number of generations a year varies with latitude. Biological constants were therefore calculated, to facilitate the forecasting of outbreaks in particular regions. It was found that the thresholds of development were 13·1, 7·7, 12·6 and 9°C. [55·58, 45·86, 54·68 and 48·2°F.] for the egg, larval and pupal stages and adult maturation, and that the temperature sums above these threshold values required for development were 45, 402, 121 and 111 day-degrees C. [81, 723·6, 217·8 and 199·8°F.]; the corresponding values for a complete generation were 9·6°C. [49·28°F.] and 685 day-degrees C. [1,233°F.]. Based on these values, the number of generations a year would vary in general from 1–2 in north-eastern China to 7–8 in southern China, and these figures agreed well with field observations. The use of isotherms for distinguishing adjacent regions varying in number of generations is suggested.

Shibuya (M.). **Effect of organic phosphorous Insecticides applied for Rice Stem Borer Control on the Leafhopper-association in Paddy Fields.**—*Mem. Fac. Agric. Kagoshima* **2** no. 2 pp. 145–152, 5 graphs, 2 refs. Kagoshima, 1956.

In an experiment in southern Japan, half a small rice-field was sprayed with 80 gal. 0·05 per cent. parathion per acre on 21st July and 200 gal. 0·1 per cent. parathion on 25th August and 1st September 1954 and with 0·2 per cent. diazinon [O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl phosphorothioate] at 80 gal. per acre on 21st July and 200 gal. per acre on 23rd and 31st August 1955, all in emulsion form, for the control of *Chilo suppressalis* (Wlk.). Samples were taken with a net throughout the field 17 times between 21st July and 18th October in 1954 and eight times between 15th July and 26th September in 1955 to ascertain the effect on the numbers of adults and nymphs of *Nephotettix apicalis* (Motsch.) (*bipunctatus* (F.)) var. *cincticeps* (Uhl.), *Sogata furcifera* (Horv.) and *Nilaparvata lugens* (Stål). All treatments tended to reduce populations of these insects, at least until late September or October, to a degree that varied with the species. In the untreated half, *Sogata* was generally predominant in July and August, *Nephotettix* in September and *Nilaparvata* in October. Little change in relative importance was evident in the sprayed half until after the second application in each year. The three test insects then became scarcer than *Anagrus* sp., their egg parasite, until the middle of October, when nymphs of *Nephotettix* became predominant, three weeks later than in untreated plots; it is evident that the insecticides had a prolonged effect in reducing the population density of the three pests.

Bailey (S. W.). **Air-tight Storage of Grain; its Effects on Insect Pests. III.** *Calandra oryzae* **(Large Strain).**—*Aust. J. agric. Res.* **8** no. 6 pp. 595–603, 3 graphs, 7 refs. Melbourne, 1957.

In this third part of a series [*cf. R.A.E.*, A **45** 157], an account is given of investigations on the effects of changes in the composition of the intergranular air on the adults and immature stages of the large strain of *Calandra oryzae* (L.) [*cf.* **33** 361] infesting grain in hermetically sealed containers. In general, the responses of both adults and immature stages were similar to those of the small strain [**45** 158] With an oxygen concentration as in air, complete mortality of the adults did not occur until the carbon-dioxide concentration rose to about 35 per cent. The maximum concentration of carbon dioxide that can be attained, even when all the oxygen is used, in wheat infested by the large strain is estimated at 17·8 per cent., and since, in the absence of carbon dioxide, all the adults died when the oxygen concentration fell to 5 per cent., at which value the concentration of carbon dioxide in the air would be about 13·5 per cent., it is concluded that the cause of death in sealed containers is lack of oxygen. Complete mortality of the adults due to lack of oxygen occurred at concentrations 0·5 per cent. higher than for the small strain. The survival of larvae up to three days old was greatly reduced by exposure to an oxygen concentration of about 10 per cent. in the absence of carbon dioxide. Many adults produced by immature stages of the small strain that had survived exposure to low concentrations of oxygen when 21–28 days old died shortly after emergence, but there was no mortality among adults of the large strain as a result of such exposure. Evidence was obtained that newly emerged adults of the large strain, unlike those of the small, do not at first feed on wheat carbohydrate, but subsist on fat reserves. It is estimated that in lightly infested grain producing 0·5 per cent. carbon dioxide in 24 hours at 29°C. [84·2°F.], the oxygen would become sufficiently depleted to cause mortality in 26 days and that mortality would be complete in a total of 40 days. In heavily infested grain with a carbon-dioxide value of 5 per cent., 17 days would be required.

CARNE (P. B.) & CHINNICK (L. J.). **The Pruinose Scarab** (*Sericesthis pruinosa* **Dalman**) **and its Control in Turf.**—*Aust. J. agric. Res.* **8** no. 6 pp. 604–616, 1 pl., 4 figs., 13 refs. Melbourne, 1957.

The larvae of *Sericesthis pruinosa* (Dalm.), which, with the adults, are briefly described, infest pasture and turf in coastal districts of eastern Australia from central Queensland to south-eastern South Australia and frequently cause severe damage to lawns and golf links [*cf. R.A.E.*, A **7** 485; **33** 161]. In 1948, this Melolonthid occurred, for the first time in the southern tableland of New South Wales, in several adjoining lawns in a suburb of Canberra, and by 1956 it had spread through most of the southern portion of the city. It was evidently introduced into this area and survives there only in watered turf. Infestation was confined to turf near certain species of *Eucalyptus*, notably *E. rubida*, *E. blakelyi* and *E. viminalis*, the leaves of which are eaten by the adults, and did not occur in suburbs without well-grown street trees or separated from infested ones by areas having few trees.

The adults were in flight from early to mid-January in Canberra during 1952–56, but flights have been recorded in late November or early December in the Blue Mountains of New South Wales and in late October or early November in southern Queensland. The females lay 20–40 eggs each among or below the roots of the grass. The larvae feed on organic matter, especially leaf mould formed from grass clippings, until the third instar, when they attack the roots of the grasses and frequently sever them. The resulting death of the turf over irregular patches within a few days provides the first indication of infestation. The larvae overwinter in the third instar, which is usually reached in March or April, and before doing so they form cells in the soil at a depth of about 1 in. below their feeding level, in which the prepupal and pupal stages are passed. Pupation takes place in spring or early summer, and the adults remain in the cells for a short period before leaving the soil. The larvae are preyed upon by birds, which, however, cause further damage in searching for them, and are also attacked by a Coccidian, which in 1955 and 1956 caused up to 65 per cent. mortality, *Bacillus lentimorbus* var. *australis* [*cf.* **46** 191], and one or more other bacteria, which cause colour changes, but none of these becomes effective until after extensive damage has occurred. The adults are parasitised by unidentified Tachinids, but only 5·2 per cent. of 134 caught at light at Canberra in 1956 were affected.

The distribution of the larvae in the turf is usually patchy. No swarms of adults were seen, but solitary females often alighted and entered the soil, so that certain sites are thought to be preferred for oviposition. Larval infestation was heaviest on light soils, in damp situations (though waterlogging in autumn and winter is unfavourable), in lawns or parts of lawns in which grasses predominated, and near trees and shrubs, even if not food-plants of the adults. It was almost or completely absent from lawns of white clover [*Trifolium repens*] or subterranean clover [*T. subterraneum*], even where they adjoined severely damaged grass lawns. Vigorous turf was less damaged than weak turf with shallow roots, and, where larvae are fairly evenly distributed, the grass first begins to die off where conditions are less favourable for it. Damage is increased by lack of moisture, organic matter or fertilisers and by too frequent or too severe cutting. Suggested preventive measures are the use or encouragement of clovers in lawns and the restriction of watering in summer.

Infested lawns treated with DDT at rates of 5–10 lb. per acre between 1948 and 1954 did not become appreciably reinfested, but the absence of controls rendered the results inconclusive. Control measures were further investigated in 1955–56. In preliminary tests with emulsion sprays of aldrin, dieldrin, endrin, chlordane, BHC and DDT applied to field plots between May and July and used as dips for larvae collected in August 1955, mortality significantly higher than in the untreated controls was given only by DDT and aldrin in the field and by these and by BHC and endrin in the laboratory, but none was outstandingly effective. The poor results were attributed to low temperatures and, possibly, the advanced developmental stage of the larvae. When the plots were again examined, in April 1956, to determine the effect of the treatments on the first-instar larvae, those treated with chlordane and endrin even at the maximum rates (10 and 5 lb. per acre, respectively) showed conspicuous infestation. In tests in March and April 1956, when the mean monthly soil temperatures at a depth of 6 in. were 68 and 60°F., respectively, aldrin gave outstanding control, but BHC and ethylene dibromide were of little value. Larvae affected, but not killed, by aldrin, dieldrin and DDT could not feed and ultimately died, though sometimes not for 10–14 days. Aldrin was used at 10 lb. per acre, and when it was used at 2–8 lb. only the highest rate gave a significant reduction; effectiveness was less in a lawn that had received a liberal top dressing of light loam, in which the larvae fed exclusively. In a comparative test of aldrin and dieldrin at 4 lb. and DDT at 10 lb. per acre in April, the percentage mortalities obtained were 97, 79 and 36, respectively; an application of DDT at 15 lb. per acre left 20 per cent. of the larvae unaffected after four weeks, and one of 10 lb. per acre 34 per cent. of them after seven weeks. In a laboratory test, most of the larvae kept at 75°F. in soil treated with aldrin at 1·6–10 lb. per acre were dead and the rest dying after 19 days; in soil treated at 0·8 lb. per acre, the few not dead or moribund showed moderately severe symptoms, but mortality was low in soil treated at 0·2 lb. per acre. When the experiment was repeated with rates of 1·6 and 10 lb. at 50°F., the mortality percentages after 19 days were less than 50 and about 20, respectively, though all the remaining larvae were moribund. It is concluded that aldrin at 1–2 lb. per acre is suitable for controlling existing infestations, but in districts such as Canberra, with severe winter frosts, prompt application as soon as infestation is detected in autumn is necessary. Dieldrin is slower in action, but less costly, and may give control for several seasons after application.

Brimblecombe (A. R.). **Control Trials against Red Scale on Figs.**—*Qd J. agric. Sci.* **15** no. 4 pp. 215–239, 14 figs., 1 ref. Brisbane, 1958.

Commercial growing of figs in Queensland is restricted to a district near Brisbane. Infestation of the trees by *Aonidiella aurantii* (Mask.) became severe after 1946, and in 1949, when almost all the figs were attacked, investigations were begun on the bionomics and control of this Coccid. Counts of adult scales made at least monthly between April 1950 and March 1952 showed that the percentage of living females in the population did not exceed 42·8 on non-bearing twigs and averaged about 50 on bearing ones. Reproduction occurred in every month, and usually over 30 per cent. of the living females were producing young. Peaks in the percentage of breeding females occurred in May–June and December–January, with a smaller one in September, and alternated with peaks in the percentage of living females. The summer breeding peak, in December–January, is the most important, since the crawlers migrate to the young twigs and infest the leaves and figs, reducing the yield and quality of the latter, whereas the autumn and winter populations are, as a result of leaf-fall and pruning, confined to the trunks and branches and normally produce non-migratory progeny.

In tests on control, single sprays of lime-sulphur (1:35), white oil (1:40) or 0·05 per cent. parathion applied on 17th August and 7th December 1949 and 3rd April 1950 reduced infestation on the leaves and figs only very slightly and were of no practical value. Two applications made a few weeks apart in August and September, December, and April or April and May during 1949 and 1950 greatly reduced populations and the percentage of living females among them and were followed by large percentages of figs almost free from infestation at harvest. White-oil emulsion appeared to result in an increase in the number and, in one case, the weight of figs harvested, but the differences were not significant. White-oil emulsion and parathion were equally effective in preventing the spread of infestation to new twigs, but parathion greatly reduced natural control by the entomogenous fungus, *Sphaerostilbe aurantiicola* (*coccophila*), *Aphytis* (*Aphelinus*) *chrysomphali* (Merc.) and Coccinellid predators, and did not check early leaf fall caused in part by the fungus, *Cerotelium fici*. Trees sprayed with oil emulsion retained most foliage, and a survey throughout the district in 1951 showed that those that received both oil emulsion and a fungicidal copper spray retained almost all their leaves until winter and continued to yield marketable figs until April. It is concluded that oil emulsion is the only effective insecticide for use against *A. aurantii*, and a schedule of two applications, 2–3 weeks apart, in January is recommended.

Johnson (B.). **Studies on the Dispersal by Upper Winds of** *Aphis craccivora* **Koch in New South Wales.**—*Proc. Linn. Soc. N.S.W.* **82** pt. 2 pp. 191–198, 2 maps, 9 refs. Sydney, 1957.

The following is almost entirely the author's summary. Large influxes of migrants of *Aphis craccivora* Koch occur in the spring of some years in the central coastal districts of New South Wales, where, when abundant, this aphid is a serious pest of cowpeas, broad beans [*Vicia faba*] and french beans [*Phaseolus*]. Evidence is given that the aphids originate from leguminous pasture plants and weeds growing over an extensive area 200–300 miles to the north-west, where the climatic conditions at the time are particularly suitable for the development of large infestations. As the season advances, conditions in the breeding area become progressively more extreme until the food-plants of the aphids die out almost completely. When the infestation is at its peak, winged migrants are produced in large numbers and as they fly off they are dispersed by winds to the surrounding districts. The arrivals of migrants in the central coast in 1951 were found to follow periods of north-westerly upper winds, which were blowing in three out of four cases for long enough, at the wind speeds recorded, to transport the aphids over the 200–300 miles in less than 24 hours. An account is given of the arrival in Sydney in 1948 of a dense swarm that had apparently been carried out to sea by the upper winds and brought in to the coast again on a sea breeze.

COMMON (I. F. B.). **The Occurrence of *Epinotia lantana* (Busck) (Lepidoptera: Olethreutidae) in Australia.**—*Proc. Linn. Soc. N.S.W.* **82** pt. 2 pp. 230–232, 2 figs., 3 refs. Sydney, 1957.

*Epinotia lantana* (Busck) was introduced into Queensland from Hawaii about 1914 for the control of the noxious weed, *Lantana*, but was later reported only once, in 1926, in northern New South Wales [*R.A.E.*, A **14** 481]. A recent investigation into its possible occurrence in Australia showed that it was widely distributed on *Lantana* in the coastal area of Queensland and in northern New South Wales and that the lack of earlier records was due to misidentifications, the moth having been described several times as a new species. Its synonymy is reviewed, the adults of both sexes are described (with their genitalia), and collecting records are listed. The only species with which it might be confused is *Crocidosema plebeiana* Zell. [*cf.* **13** 231; **31** 265], which was apparently introduced from the Mediterranean area, and characters differentiating the two are described.

MADGE (P. E.). **The Ecology of *Oncopera fasciculata* (Walker) (Lepidoptera: Hepialidae) in South Australia. V. Changes in the Environment of *O. fasciculata* associated with the Development of County Grey for Agriculture.**—*Aust. J. Zool.* **6** no. 1 pp. 19–26, 2 pls., 17 refs. Melbourne, 1958.

The following is virtually the author's summary of this fifth part of a series [*cf. R.A.E.*, A **47** 288, etc.]. Before County Grey, in the south-east of South Australia, was developed for agriculture, *Oncopera fasciculata* (Wlk.) probably was restricted by excessive wetness to the higher, drier portions of the poorly drained soils, and by dryness to the lower, moister portions of the well-drained soils. Even in these places it probably was not able to maintain large numbers because suitable food was scarce. Steps in the development of the area for agriculture have included artificial drainage, clearing of woodland and scrub, the use of phosphatic and trace-element fertilisers, and the establishment of pastures consisting of subterranean clover (*Trifolium subterrancum*) and other introduced clovers and grasses. This development has provided a more favourable environment for *O. fasciculata*. Artificial drainage reduced the chances of exposure to excessive wetness, and the establishment of pastures composed of clovers and perennial grasses not only provided protection for the eggs and young larvae against evaporation, but also made available a greater amount of good-quality food for the larvae.

RIMES (G. D.). **The Bark Beetle in West Australian Pine Forests.**—*J. Dep. Agric. W. Aust.* (3) **8** no. 3 pp. 353–355, 2 figs., 6 refs. Perth, W.A., 1959.

*Ips grandicollis* (Eichh.), a North American Scolytid that was first recorded in Australia from pine plantations in South Australia, has been known over the past ten years to occur in pine plantations near Perth, in Western Australia. Attack is confined to felled trees, slash, dead limbs and tops, dying trees, and trees damaged by fire or lightning. It normally occurs in slash accumulated during thinning operations, and populations build up rapidly when these are carried out in summer. Logs less than about 3 in. in diameter and those with thick bark are not attractive. The life-cycle of the beetle, which is briefly described, is completed in 4–5 weeks in summer, and the adults are usually active from September to May, during which period about six generations develop. Winter is passed mainly by adults beneath the bark, but the larvae are also able to survive. The beetles transmit a wood-staining fungus [*cf. R.A.E.*, A **23** 1] and cause desiccation of the logs by destroying the junction of the inner bark and the sapwood, which reduces their value for plywood; in addition, they cause some mechanical damage.

The Scolytid is too widely distributed for eradication to be practicable, but populations can be reduced by the destruction of slash and infestation of logs prevented by removal within 48 hours of felling. In tests of insecticides in 1956–59 at the plywood factories, where there are reservoirs of infestation, sprays were applied by power equipment to the ends of piles containing approximately 20 logs each, at a rate of 2 gal. per 50 cu. ft. wood, so that they passed through the length of the pile, and the protection given was assessed two months later from the number of holes found when the bark was removed from the centre foot of each log. As a result of preliminary work, lindane [almost pure γ BHC] and endrin were selected, and additional tests showed that emulsion sprays of 0·3 per cent. γ BHC or 0·5 per cent. endrin gave protection for two months. γ BHC was half as costly as endrin. In 1958–59 an emulsion spray of 0·5 per cent. Thiodan [6,7,8,9,10,10-hexachloro-1,5,5a,6,9,9a-hexahydro-6,9-methano-2,4,3-benzodioxathiepin-3-oxide] was found to be only slightly inferior to 0·3 per cent. γ BHC.

MARTYN (E. J.) **The Effect of Sprays of D.D.T. and B.H.C. on the Pasture Cockchafer,** *Aphodius pseudotasmaniae* **Given, in Tasmania.**—*Tasm. J. Agric.* **30** no. 2 pp. 156–158, 3 refs. Hobart, 1959.

The following is based on the author's summary. The occurrence of incipient attack by *Oncopera intricata* Wlk. in pastures infested by *Aphodius* assumed importance in Tasmania in 1958, and a test was conducted to determine whether the addition of DDT for the control of *Oncopera* [*cf. R.A.E.*, A **46** 75] to sprays of BHC applied against *A. pseudotasmaniae* Given [*cf.* **45** 451] would permit any reduction in the amount of BHC required to control the latter. Sprays of γ BHC at 2 and 4 oz. per acre, p,p′DDT at 4, 8, 12, 16 and 20 oz. per acre, γ BHC at 4 oz. with p,p′DDT at 8 oz. per acre and γ BHC at 2 oz. with p,p′DDT at 4, 8 or 12 oz. per acre were applied to plots by knapsack sprayer on 24th July 1958, and sampling was carried out by counting the larvae in six areas, each 1 ft. square, per plot between 1st and 4th September, at which time the larvae were still feeding. All treatments except DDT alone at 4 oz. per acre caused highly significant reductions in *Aphodius*. The BHC treatments with or without DDT were outstanding, and the plots receiving them contained an average of 3·1–5·4 larvae per sq. ft. The plots receiving DDT at 8–20 oz. per acre contained averages of 10·5–23·8, and the untreated controls 34·3. The addition of DDT did not significantly improve the control given by BHC and it is concluded that the current recommendation of 4 oz. γ BHC with 8 oz. p,p′DDT per acre against both insects cannot at present be altered.

MOOREFIELD (H. H.) & TEFFT (E. R.). **Application of Cholinesterase Assay to Residue Analysis of 1-Naphthyl N-methylcarbamate (Sevin).**—*Contr. Boyce Thompson Inst.* **19** no. 4 pp. 295–301, 1 graph, 11 refs. Yonkers, N.Y., 1958.

The following is based on the authors' summary. The cholinesterase technique, now in use for estimating residues of various organic phosphorus insecticides [*cf. R.A.E.*, A **43** 406], was satisfactorily adapted for use with Sevin (1-naphthyl N-methylcarbamate). Recovery of fortified samples from diversified plant products, such as lettuce, peas, pea pods, apples and the foliage of beans and cotton, was excellent, and the results of enzymatic determination of residues on field-treated apples were confirmed by chemical analysis. In the general procedure, the commodity is stripped with chloroform, the solvent evaporated and the Sevin estimated enzymatically by measuring the extent to which it inhibits brain cholinesterase from heads of house-flies (*Musca domestica* L.). The method is sensitive to 0·5 μg. Sevin.

HARTZELL (A.), BURCHFIELD (H. P.) & COTTY (V. F.). **Improvements in culturing Larvae of** *Aedes aegypti* **(L.) for Use in Insecticide Bioassay.** —*Contr. Boyce Thompson Inst.* **19** no. 4 pp. 321–325, 4 refs. Yonkers, N.Y., 1958.

The authors describe improvements in the method previously adopted [*cf. R.A.E.*, A **42** 265] for rearing larvae of *Aëdes aegypti* (L.) for use in the bioassay of insecticides [*cf.* **44** 127, etc.]. The principal changes include the use of deionised water, reconstituted to a standard ionic strength by the addition of physiological salt mixture, as the rearing medium; adjusting the temperature to 31°C. [87·8°F.]; and altering the ratio of brewers' yeast, blood albumin and sucrose to 10:3:2 and the concentration of 0·25 per cent. nutrient suspension in water to 225 ml. per 8 litres. Under these conditions, second-instar larvae were obtained with great regularity 22 hours after the addition of the nutrient to the medium, which eliminated the need to segregate first-instar larvae and resulted in considerable saving of time and effort.

CLIFFORD (P. A.). **Pesticide Residues in Fluid Market Milk.**—*Publ. Hlth Rep.* **72** no. 8 pp. 729–734, 10 refs. Washington, D.C., 1957.

More than 60 per cent. of 801 samples of market milk collected in a countrywide survey in the United States in the autumn of 1955 and examined by bioassay with flies [*Musca domestica* L.] gave evidence of the presence of chlorinated insecticides. Most of these were in trace amounts and were not identified specifically. The 160 samples giving the highest kills were examined by paper chromatography, and 169 by the Schechter-Haller method [*R.A.E.*, A **40** 347, etc.], mainly for confirmation. DDT, technical BHC, γ BHC (lindane), DDD, methoxy-DDT (methoxychlor) or DDE [1,1-di(p-chlorophenyl)-2,2-dichloroethylene] or more than one of these compounds were identified in many of the samples by paper chromatography. In the Schechter-Haller test, 89 of the 169 samples were positive, showing amounts of DDT and its decomposition products, metabolites or both ranging from a trace (0·03 part per million) to 1·46 p.p.m. However, the latter figure is not accurate for DDT because DDD, which interferes with the test, was also detected in the sample on the chromatogram. In almost all cases, the colorimetric and chromatographic results were in at least qualitative agreement. An *in vitro* cholinesterase-inhibition test failed to reveal the presence of any organic phosphorus insecticide. The source of the contamination with chlorinated compounds is not known; they may have resulted from residues on forage or from sprays applied to barns or to the cows themselves. A limited follow-up survey carried out during the winter of 1956–57 in four districts revealed little or no contamination of market milk with either DDT or BHC.

SHENEFELT (R. D.), STELZER (M. J.), PASCOE (T. A.) & KILP (F. G.). **Spraying Jack Pine Pulp Logs.**—*Agric. Chem.* **13** no. 1 pp. 38–40, 6 refs. Baltimore, Md., 1958.

Investigations on the economic value of spraying pulpwood from jack pine [*Pinus banksiana*] for the control of insects were begun in the United States in 1955. Logs were cut in Minnesota between 11th July and 18th August, left rough and either sprayed with wettable BHC (12 per cent. $\gamma$ isomer) to give about 1 oz. $\gamma$ BHC in 1 U.S. gal. water per cord as they were piled on the day of cutting or not sprayed, and they were compared with similar logs cut in April–July and peeled. Tests on wood cut in March and April demonstrated the need for protection against insects and the failure of spraying after infestation had occurred. By 1st August, rough unsprayed and sprayed wood cut on 11th–15th July had 17·57 and 0·28 insect attacks per sq. ft., respectively. The wood was shipped to the mill in January–February and examined in August 1956, when the sprayed rough wood showed 71·4, 4·2, 97·2 and 81·5 per cent. fewer attacks by bark-beetles, Buprestids, Cerambycids and all insects together, respectively, and 41·4 and 38·9 per cent. less blue-stain infection and surface decay than the untreated rough wood, and it was pulped and made into paper a month later. The peeled wood had an average moisture content of 19·5 per cent., less than that required by most decay organisms, and the rough wood about 30 per cent.; the sprayed and unsprayed rough wood was 1·6 and 4·3 per cent. less dense, respectively, than the peeled wood, owing to insect and possibly fungus damage, and yielded about 1·8 and 4·6 per cent. less pulp. Cerambycids were responsible, directly or indirectly, for practically all the loss. Injury was less than usual in the untreated rough wood in these tests, and calculations of the cost of treatment and the gains obtained led to the application of the treatment on a large scale in the Lake States. Wood cut early in the season is sprayed before the beetles become active, and that cut during the time of insect activity as it is stacked.

NAGEL (R. H.), MCCOMB (D.) & KNIGHT (F. B.). **Trap Tree Method for controlling the Engelmann Spruce Beetle in Colorado.**—*J. For.* **55** no. 12 pp. 894–898, 6 refs. Washington, D.C., 1957.

*Dendroctonus engelmanni* Hopk. is the most important pest of Engelmann spruce (*Picea engelmanni*) in the United States. Outbreaks of this bark-beetle are difficult to prevent because they develop in wind-damaged stands, and large areas have been affected in Colorado [*cf. R.A.E.*, A **44**

369] during the last century. Investigations on the effectiveness of groups of trap trees, consisting of living trees of merchantable size, felled to attract the beetles and subsequently milled and burnt or treated with insecticide, were begun in 1949. The results showed that they were of considerable value as a supplement to chemical control [*cf.* **42** 285]; they attracted more beetles than standing trees in the vicinity and were more heavily infested if felled in autumn than in spring and in well-shaded sites than in sunny ones. Competition from species of *Ips* was of little importance provided that the trap logs were not exposed to full sunlight, did not have their branches lopped and were felled at times that missed the peak of *Ips* flights, which appear to occur after mid-June, in August and in late September. The logs attracted *D. engelmanni* for distances of 0·25–0·5 mile, and single logs absorbed as many beetles as ten standing trees of comparable size. Girdled standing trees were no more attractive than normal ones.

STRUBLE (G. R.). **Biology and Control of the White-fir Sawfly.**—*For. Sci.* **3** no. 4 pp. 306–313, 5 figs., 2 refs. Washington, D.C., 1957.

The following is based on the author's summary. An outbreak of *Neodiprion abietis* (Harris) on white fir (*Abies concolor*) in forests in California in 1951–55 resulted in drastic reduction in the growth of heavily defoliated trees and some killing of suppressed ones. Investigations in 1952–55 showed that most of the population had a one-year life-cycle. Mating and oviposition occurred in the last two weeks of October, the eggs being laid under the epidermis along the edges of needles, the larvae hatched between 15th May and 15th June, passed through five feeding instars on the older foliage and then left the trees and spun cocoons in the soil or débris between 20th and 25th July. Most individuals pupated and transformed to adults by late October, but a small proportion overwintered as prepupae; these are believed to give rise to adults in the following October. A native epizootic polyhedral virus caused great reductions in larval populations in 1953 and subsequent years; infection appeared in the fourth and fifth instars. Several insect enemies were observed; those identified included the Coccinellids, *Neomysia subvittata* (Muls.) and *Anatis rathvoni* Lec. which were common predators, and *Exenterus tsugae* Cushm. and *Tritneptis klugii* (Ratz.), which were common parasites of the larvae, but their importance in control was not determined. A spray of 1 lb. DDT in 1 U.S. gal. fuel oil per acre applied from an aeroplane as soon as possible after the larvae hatched gave 95–100 per cent. mortality in 1953.

GENTILE (A. G.) & SUMMERS (F. M.). **The Biology of San José Scale on Peaches with special Reference to the Behavior of Males and Juveniles.** —*Hilgardia* **27** no. 10 pp. 269–285, 3 figs., 15 refs. Berkeley, Cal., 1958.

The following is based on the authors' summary of this account of investigations on the bionomics of *Quadraspidiotus perniciosus* (Comst.) on peach in the interior valley of California. Data on the life-cycle and duration of stages of the scale were obtained from isolated colonies or individuals established on potted peach trees and from samples of infested bark taken from commercial orchards at frequent intervals throughout the seasons of 1953–56. Colonies and individuals reared on potato tubers contributed supplemental information.

Observations on isolated cultures indicated that the Coccid has three major generations a year, all of which overlap in the autumn. Crawlers of the first generation are produced during April, May and June, are most numerous in late May and early June and give rise to adults during July or later; the latter reproduce until the end of September. Crawlers of the second generation appear in July and August and give rise to adults that reproduce during September and October, and those of the third generation are produced during September, October and November. Some of the crawlers produced during September and October mature and the resulting adults mate before the onset of winter, whereas others produced in October and November overwinter as inactive first-stage nymphs in the black-cap phase. The latter comprise about 80 per cent. of the population in January; they resume development during February, but do not reproduce until April or later.

Experiments with isolated unfertilised females showed that the scale does not reproduce parthenogenetically; the females survived for relatively long periods, but did not produce embryonated eggs. Descriptions are given of the birth process, the way in which the crawlers fix themselves to the tissues of the food-plant, and the processes of moulting and the formation of the scale cover. The geographical distribution, food-plant range and methods of dispersal of the Coccid are also discussed.

Lider (L. A.). **Phylloxera-resistant Grape Rootstocks for the coastal Valleys of California.**—*Hilgardia* **27** no. 11 pp. 287–318, 2 figs., 25 refs. Berkeley, Cal., 1958.

The following is based on the author's summary. *Phylloxera vitifoliae* (Fitch), which infests vines, was introduced into California before 1860 and has since spread generally over the State; only the parthenogenetic root-infesting form is usually present [*cf. R.A.E.*, A **36** 398], and the extent of infestation and its intensity within a given area are markedly influenced by soil and climate. Investigations during the past 50 years on resistant rootstocks for grafting provided a basis for selecting a limited number for co-operative field tests in vineyards scattered throughout the coastal valleys, which are important grape-growing areas. These were tested to evaluate their performance when grafted with scions of various fruiting varieties under a wide range of environmental conditions.

The results of the early tests showed considerable disagreement with those obtained on grafted vines in the commercial vineyards of the State and a distinct discordance in the behaviour of the same stocks with the same scion variety in different localities. A statistical survey of the data collected showed that the most popular rootstock used commercially, Rupestris St. George (synonym Rupestris du Lot), is not the most suited under the conditions tested, whereas the experimental stock Aramon × Rupestris Ganzin no. 1 was generally the most vigorous and productive of the stocks under consideration.

Frazier (N. W.) & Posnette (A. F.). **Relationships of the Strawberry Viruses of England and California.**—*Hilgardia* **27** no. 17 pp. 455–513, 4 col. pls., 29 figs., 52 refs. Berkeley, Cal., 1958.

The following is based largely on the authors' summary. Comparison of the viruses known to infect strawberry in California and in England showed that five occur in both areas, seven only in England and five only in California, and that a leaf-curl virus, transmitted by *Amphorophora rubi* (Kalt.), is known only in plants in the greenhouse of the East Malling Research Station, Kent.

Tests in England with *Capitophorus fragaefolii* (Ckll.) and in California with *C.* (*Pentatrichopus*) *thomasi* (H. R. L.) and its subspecies *jacobi* (H. R. L.) [which were previously misidentified by American authors as *C. fragaefolii* (*cf. R.A.E.*, A **29** 27)] showed that the viruses studied could be grouped provisionally according to their symptoms and their relations with their vectors and host-plants, but the evidence obtained did not clearly define the level of relationships among the viruses within the groups. Comparative tests suggested that the incubation period for the development of symptoms in the plant and the rate of virus loss by vectors are useful characters distinguishing between strawberry viruses, but the acquisition threshold period and rate of virus acquisition appeared to be less useful.

Newly described viruses that were transmitted by the aphids were curly-dwarf mottle in both areas, rusty-leaf mottle and lesion-B, a crinkle virus, in England and lesion-A and yellow vein banding in California. Viruses of the mottle group have been transmitted by *Myzus ornatus* Laing, *M. ascalonicus* Doncaster and *Macrosiphum* (*Acyrthosiphon*) *malvae* subsp. *rogersii* Theo. in England, where all three aphids may be of some importance as field vectors when sufficiently numerous to outweigh their comparative inefficiency in transmission, and by *Aphis gossypii* Glov. and the five species recorded by Frazier in California [**39** 319], including the typical *M. malvae* (Mosley) (*pelargonii* (Kalt.)), among which *A. gossypii* and *Myzus ornatus* may be of importance in the field.

McGrath (H.) & Miller (P. R.). **Some important Developments in Plant Diseases in the United States in 1958.**—*FAO Plant Prot. Bull.* **7** no. 9 pp. 117–120, 1 fig. Rome, 1959.

It is stated in the course of this report that the hoja blanca disease of rice, which was observed for the first time in the United States in Florida in 1957 [*R.A.E.*, A **47** 31], was found on 1st October 1958 on rice at two places in Hancock County, Mississippi, which is an important rice-growing State. *Sogata orizicola* Muir, the only known vector of the virus, was discovered in a rice-field in the same county. Neighbouring areas were free from the disease and the Delphacid.

Sheffield (F. M. L.). **Virus Diseases of Sweet Potato in East Africa. II. Transmission to alternative Hosts.**—*Phytopathology* **48** no. 1 pp. 1–6. 5 figs., 9 refs. Baltimore, Md., 1958.

The following is based on the author's summary of this account of further investigations on the two virus diseases of sweet potato (*Ipomoea batatas*) found in East Africa [*cf. R.A.E.*, A **46** 497]. Virus A was transmitted by grafting, but not mechanically, to several species of *Ipomoea*, and *Myzus persicae* (Sulz.) failed to transmit it to several solanaceous plants. Virus B, which is the more important of the two, was not transmitted mechanically to sweet potato, but was so transmitted to some other plants. Plants of several species of *Ipomoea* and of some members of the Solanaceae became infected with virus B when inoculated mechanically, by graft or by means of *Bemisia tabaci* (Gennadius). All such plants showed systemic symptoms that varied in intensity among the species. In *Gomphrena globosa*, the virus was confined to local lesions. All attempts to transmit virus B to members of the Chenopodiaceae, Compositae, Euphorbiaceae and Malvaceae failed. Both viruses seem to be distinct from others described in sweet potato; virus B could not be identified with any of the viruses previously recorded as transmitted by *B. tabaci*.

Corbett (M. K.). **A Virus Disease of Lupines caused by Bean Yellow Mosaic Virus.**—*Phytopathology* **48** no. 2 pp. 86–91, 27 refs. Baltimore, Md., 1958.

The following is virtually the author's summary. The principal virus disease of blue, yellow and white lupins (*Lupinus angustifolius*, *L. luteus*, and *L. albus*, respectively), grown for seed and forage in the south-eastern United States, is caused by strains of bean yellow mosaic virus. The symptoms produced in diseased blue lupins are similar to those attributed to infection by pea mosaic virus in Australia and New Zealand. Diseased yellow lupins exhibit symptoms similar to those described as being induced by *Lupinus* virus 1 in Holland.

Experimentally, the host range of the viruses isolated was limited to leguminous plants. All tested species of the genus *Lupinus* were susceptible except six perennial species. The virus was transmitted in a non-persistent manner by *Myzus persicae* (Sulz.) and *Aphis craccivora* Koch (*medicaginis*, auct.). Positive immunological relations with strains of bean yellow mosaic virus were demonstrated. The virus is transmitted through 6·2 per cent. of the seed from diseased plants. The main field sources of the virus in northern Florida are the sweet clovers (*Melilotus* spp.) that grow as perennials.

Cherewick (W. J.) & Robinson (A. G.). **A Rot of smutted Inflorescences of Cereals by** *Fusarium poae* **in Association with the Mite** *Siteroptes graminum*.—*Phytopathology* **48** no. 4 pp. 232–234, 5 figs., 4 refs. Baltimore, Md., 1958.

The following is largely the authors' summary. The mite, *Pediculoides* (*Siteroptes*) *graminum* (Reut.), in close association with *Fusarium poae*, developed abundantly in smutted inflorescences of cereals in the greenhouse in Manitoba. In humid summer weather it also occurred in field plots of wheat, oats, barley and rye. The affected inflorescences failed to emerge from the sheaths and were eventually destroyed by a wet rot resulting from the combined action of mite and fungus. When female mites, with their bodies distended, were plated on agar, colonies of *F. poae* developed, even after surface-sterilisation of the mites. The mite was controlled in the greenhouse by spraying plants weekly with 0·05 per cent. endrin, beginning when they were in the four-leaf stage.

Gilmer (R. M.) & McEwen (F. L.). **Insect Transmissions of X-disease Virus.** (Abstract.)—*Phytopathology* **48** no. 5 p. 262. Baltimore, Md., 1958.

A technique for rapid transmission of the virus of X-disease by leafhopper vectors was developed. The virus was initially transmitted from infected seedlings of chokecherry [*Prunus virginiana*] to seedlings of periwinkle (*Vinca rosea*). Infected periwinkle plants showed marked floral and foliar symptoms and remained acceptable to many possible vector species for long periods. Suspected vectors were permitted an acquisition period of 5–10 days on infected plants and were then transferred to healthy periwinkle seedlings and allowed to feed for 25 days. Under these conditions, the virus was transmitted by *Fieberiella florii* (Stål), *Scaphytopius acutus* (Say) and *Gyponana striata* (Burm.). Symptoms appeared in 4–6 weeks. The virus was transmitted from chokecherry to periwinkle, from periwinkle to periwinkle, and from periwinkle to peach by nymphs and adults of *F. florii*. Nymphs of this species also transmitted the virus to peach from periwinkle plants originally infected by means of dodder transmission. Attempts to transmit the virus to aster [*Callistephus*] with *F. florii*, *Macrosteles fascifrons* (Stål) and dodder were unsuccessful.

Littau (V. C.) & Maramorosch (K.). **Cytopathogenic Effects of the Aster Yellows Virus on its Insect Vector.** (Abstract.)—*Phytopathology* **48** no. 5 p. 263. Baltimore, Md., 1958.

The earlier report [*R.A.E.*, A **45** 202] that the fat-body cells of the vector of aster-yellows virus, *Macrosteles fascifrons* (Stål), undergo characteristic changes after the vector has acquired the virus by feeding on diseased plants was confirmed. The nuclei become stellate; basophilic cytoplasmic material becomes stringy and sparse and apparently is easily torn. Cell boundaries are not easily seen. In contrast, nuclei of fat-body cells of non-viruliferous insects tend to be round or to possess smooth contours. The cytoplasm is generally homogeneous, with numerous vacuoles of varied size enclosed with a definite cell membrane. Virus-induced changes are seen better in males than in females. Cytopathogenic changes occur after the insects have fed on diseased plants for 18–28 days. Other insects that had been injected with the juice of viruliferous insects and allowed to feed on immune rye plants or on healthy asters [*Callistephus*] for 28 days also developed typical changes in the fat-body. These results indicate that this plant virus causes a disease in its insect vector.

Freitag (J. H.). **Cross-protection Tests with 3 Strains of the Aster Yellows Virus in Host Plants and in the Aster Leafhopper.** (Abstract.)—*Phytopathology* **48** no. 8 p. 393. Baltimore, Md., 1958.

Three strains of aster-yellows virus isolated in California were designated the severe, dwarf, and Tulelake strains. They differed in symptoms produced on *Nicotiana rustica* and *Plantago major*. Plants inoculated with the dwarf strain before the severe or the Tulelake strain developed predominantly dwarf symptoms; plants inoculated with the Tulelake strain before the dwarf or the severe strain developed only initial Tulelake symptoms and then recovered, although some plants later developed greatly delayed symptoms of the challenging strain. Individual aster leafhoppers [*Macrosteles fascifrons* (Stål)] that fed for two weeks on the dwarf and then for two weeks on the severe strain mostly transmitted only the first strain on which they fed. Likewise, leafhoppers that fed for two days on the severe and dwarf strains alternately for 20 days mostly transmitted only one or the other. In contrast, leafhoppers that fed two weeks on the Tulelake strain and then for two weeks on the dwarf strain all transmitted only Tulelake at first. Later, 16 out of 24 changed abruptly, transmitting only the dwarf strain, though the other eight continued to transmit only Tulelake. The results indicated similar interactions of the virus strains in both insect and plant hosts, depending on sequence and combination of strains used.

JENSEN (D. D.). **Reduction in Longevity of Leafhoppers carrying Peach Yellow Leaf Roll Virus.** (Abstract.)—*Phytopathology* **48** no. 8 p. 394. Baltimore, Md., 1958.

Nymphs of *Colladonus montanus* (Van D.) were allowed feeding periods of 3–17 days on celery infected with peach yellow leaf-roll virus. After completion of the virus incubation period in the leafhoppers (about 30 days), adults were caged singly on healthy celery plants and transferred daily to new plants until the insects died. The longevity of the leafhoppers was measured from the first day on the test plants. In seven experiments involving 60 individuals, 39 of the 60 leafhoppers transmitted virus. The percentage of insects proving to be infective was usually proportional to the access time on the inoculum plant. Thus, only 27 per cent. became infective after three days on the diseased plant, but 90 per cent. acquired virus in 16 days. The insects that transmitted virus lived for 6–79 days, with an average of 22. The non-transmitters lived for 8–132 days, averaging 55, and the difference was highly significant. One hypothesis suggested by these results is that peach yellow leaf-roll virus may have pathological effects in the insect vector as well as in the plant host.

SIMONS (J. N.). **Vector Efficiency of Transmission of 2 Pepper Viruses as influenced by Species and Clone of Aphid.** (Abstract.)—*Phytopathology* **48** no. 8 p. 397. Baltimore, Md., 1958.

Efficiency of transmission of southern cucumber mosaic virus in pepper [*Capsicum*] was measured with a single clone of *Myzus persicae* (Sulz.) and three clones of *Aphis gossypii* Glov. over a period of three years. Transmission of vein-banding mosaic virus in pepper was measured with two clones of *M. persicae* and the three of *A. gossypii* over a two-year period. Each clone transmitted each virus with different, but characteristic, efficiencies, which remained constant during the period of sampling. Attempts to change vector efficiency by changing the food-plant of the aphid clone sometimes succeeded, but this change was not as great as would be expected if the food-plant were the primary reason for the variation. Clones that were poor vectors of one virus were poor vectors of the other [*cf. R.A.E.*, A **47** 115].

LONG (D. B.) & ZAHER (M. A.). **Effect of larval Population Density on the adult Morphology of two Species of Lepidoptera,** *Plusia gamma* **L. and** *Pieris brassicae* **L.**—*Ent. exp. appl.* **1** no. 3 pp. 161–173, 4 figs., 23 refs. Amsterdam, 1958. (With a Summary in German.)

The following is virtually the authors' summary. The morphological effects of population density in locusts in the production of " phases " is now well established, and in recent years somewhat parallel effects have been observed in the larvae of Lepidoptera [*cf. R.A.E.*, A **32** 284, 285]. Unlike locusts, Lepidoptera pass through a quiescent pupal period, but nevertheless the adult may be affected. In laboratory experiments with both *Autographa* (*Plusia*) *gamma* (L.) and *Pieris brassicae* (L.), adults from crowded larval cultures were smaller in both size and weight, although the effect was counteracted to some extent by approaching pupal diapause in *P. brassicae*. The effect was similar in many cases to that produced by an increase in temperature, except that it disturbed the relationships between the lengths of the wing and hind femur with the live weight. The ratio of these lengths (equivalent to the E/F ratio in locusts) was significantly increased but was not a satisfactory index of larval population density. No effects were observed in the wing pattern and coloration of either species.

van den Assem (J.) & Kuenen (D. J.). **Host Finding of** *Choetospila elegans* **Westw. (Hym. Chalcid.) a Parasite of** *Sitophilus granarius* **L. (Coleopt. Curcul.).**—*Ent. exp. appl.* **1** no. 3 pp. 174–180, 1 graph, 11 refs. Amsterdam, 1958. (With a Summary in German.)

The Pteromalid ectoparasite, *Chaetospila elegans* Westw., appeared in 1953 in a culture of *Calandra* (*Sitophilus*) *granaria* (L.) in a laboratory in Holland [*cf. R.A.E.*, A **46** 284]. Observations showed that only larvae in the third or fourth, or occasionally in the second, instar were parasitised by it and that they were detected within the wheat kernels through mechanical stimuli set up by their own activities, which can be imitated by other organisms moving within a hollow grain. This was in agreement with the selection by the ovipositing females of the grains containing the largest of the active stages of the weevil. Free larvae were not attacked. Egg and larval development together lasted about 10 days at 25°C. [77°F.] and 70 per cent. relative humidity, adult emergence began on the 19th and 21st days after oviposition for males and females, respectively, and half the population emerged before the 25th day. Adult females lived for 2–3 weeks, and males for somewhat less.

Jermy (T.). **Untersuchungen über Auffinden und Wahl der Nahrung beim Kartoffelkäfer** (*Leptinotarsa decemlineata* **Say**). [The Finding and Selection of Food by *L. decemlineata.*]—*Ent. exp. appl.* **1** no. 3 pp. 197–208, 3 figs., 26 refs. Amsterdam, 1958. (With a Summary in English.)

The author describes laboratory and field observations in Hungary showing that most of the overwintered adults of *Leptinotarsa decemlineata* (Say) migrate from their winter quarters before feeding and that their perception of potato plants in the field is limited to a few decimetres. Newly emerged adults require some training before reacting to the olfactory stimuli from the plant, and sight plays a very limited part in plant finding for both young and old beetles. In searching for plants, young beetles move in a constant direction. Selection of plants depends mainly on taste, and is based principally on negative reactions to repellent stimuli. Repellency is independent of chemical structure, and a reduction in the biotic potential of the pest could be achieved by changing the quantity of accepted and rejected principles in the plant (by selection or cultural methods) or by applying a repellent, such as bordeaux mixture.

Buhr (H.), Toball (R.) & Schreiber (K.). **Die Wirkung von einigen Pflanzlichen Sonderstoffen, insbesondere von Alkaloiden, auf die Entwicklung der Larven des Kartoffelkäfers** (*Leptinotarsa decemlineata* **Say**). [The Effect of some Plant Chemicals, particularly Alkaloids, on the Development of Larvae of *L. decemlineata.*]—*Ent. exp. appl.* **1** no. 3 pp. 209–224, 1 graph, 13 refs. Amsterdam, 1958. (With a Summary in English.)

The following is based on the authors' summary. Details are given of laboratory experiments in which 83 alkaloids, saponins and other naturally occurring substances and their derivatives were tested for their effect on the larvae of *Leptinotarsa decemlineata* (Say), particular attention being given to the alkaloid-glycosides of solanaceous plants. It was found that whereas tomatin was mainly repellent in action, nicotine had a pronounced toxic effect, even in small quantities. Compounds that resembled one or other of these in their effects are noted. Some further compounds were intermediate between these two groups, and some had no effect.

TAMBS-LYCHE (H.) & KENNEDY (J. S.). **Relation between Growth Pattern and Resistance to** *Aphis fabae* **Scopoli in three Varieties of Field Bean** (*Vicia faba* **L.**).—*Ent. exp. appl.* **1** no. 3 pp. 225–239, 4 figs., 19 refs. Amsterdam, 1958. (With a Summary in German.)

The following is substantially the authors' summary of this account of experiments carried out in England in 1952. Two German varieties of field beans (*Vicia faba*), Rastatt (which is known to be relatively resistant to *Aphis fabae* Scop.) and Schlanstedt (which is very susceptible) and an English tick bean were sown in plots, and records were kept of the growth of the plants and of the daily incidence of alates of *A. fabae* and *Macrosiphum* (*Acyrthosiphon*) *pisum* (Harris), an insecticide being applied at intervals to minimise damage to the plants. Schlanstedt was the first to flower and fruit, Rastatt intermediate and the tick beans last, with the most shoots, leaves and flowers. Yields were about the same from Schlanstedt and Rastatt, and somewhat lower from the tick beans. The relative incidence of *A. fabae* both among the organs of one variety and between varieties was correlated with growth pattern. The smaller number of aphids on Rastatt, as compared with both Schlanstedt and tick, was associated with the "compromise" growth pattern of Rastatt, wherein growth was more equally divided between shoots and fruits, and apparently less vigorous in the individual organs, during the critical weeks.

These observations, together with the contrasted behaviour of *M. pisum* and previous work on phloem sap composition in relation to plant growth and aphid nutrition, suggest that the sap may have been least nutritious for aphids in Rastatt, and that the resistance of Rastatt to *A. fabae* may have been due to the winged migrants responding to some superficial plant features associated with growth pattern and sap composition. Possible practical implications are mentioned.

SIDOR (C.). **Susceptibility of Larvae of the Large White Butterfly** (*Pieris brassicae* **L.**) **to two Virus Diseases.**—*Ann. appl. Biol.* **47** no. 1 pp. 109–113, 10 refs. London, 1959.

No polyhedral virus disease has so far been recorded from *Pieris brassicae* (L.), but in the laboratory studies here described, which were carried out in 1957–58, a cytoplasmic polyhedral virus obtained from larvae of *Phalera bucephala* (L.) induced polyhedrosis in larvae of two stocks that had recently been initiated from larvae collected at two places in eastern England; a third stock that had been reared for many years in the laboratory proved immune. Infection was obtained by allowing first-instar larvae to feed for three days on leaves that had been sprayed with a suspension of the virus and subsequently dried for four hours at room temperature. Infected larvae were stunted and sluggish, appeared dark owing to shrivelling, and soon ceased feeding; the mid-gut of recently dead larvae was flaccid and milk-white in colour. Mortality from infection amounted to 41·5 per cent. in one of the susceptible stocks, but only 9·3 per cent. in the other, and the corresponding percentages in another experiment, in which the larvae fed for four days on the infected leaves and the laboratory stock was again completely resistant, were 64·5 and 2·8. The three stocks also differed in susceptibility to the granulosis virus of *Pieris brassicae*, the same one being the most susceptible to both viruses. Larvae infected with either disease died within 30 days, but whereas half the mortality from granulosis occurred within the first ten days and only 6·3 per cent. of the total during the last five-day period after infection, the polyhedrosis was slower in action, half the mortality being caused in 15 days and 13·5 per cent. of the total in the last five days. Polyhedra obtained from recently dead larvae of *P. brassicae* were infective for larvae of *Lymantria monacha* (L.), but not for those of *Plutella maculipennis* (Curt.), which also failed to become infected with the granulosis virus, or *Pseudaletia unipuncta* (Haw.).

JEPSON (W. F.) & HEARD (A. J.). **The Frit Fly and allied Stem-boring Diptera in Winter Wheat and Host Grasses.**—*Ann. appl. Biol.* **47** no. 1 pp. 114–130, 24 refs. London, 1959.

The following is based partly on the authors' summary. Sampling for stem-boring larvae was undertaken in 1954–56 on ley plots of *Lolium perenne*, *Dactylis glomerata*, *Festuca arundinacea*, *F. rubra*, *Agrostis tenuis* and *Poa pratensis* in randomised experiments at a place in Berkshire, at which the growth of wheat was seriously affected by the larvae, and the results were supplemented by observations at another place in the same county. The samples showed infestation by the larvae of 12 species of Diptera, mainly of the genera *Oscinella*, *Meromyza* and *Opomyza*, in addition to Cecidomyiids. More larvae were found on plots grazed throughout the season than on those on which grazing had been preceded by early mowing, and numbers tended to be greatest where tiller density was highest. The total numbers of larvae in November varied between 0 and 688 per sq. yard. *P. pratensis* and *L. perenne* consistently contained most larvae. The maximum density occurred in a grazed sward of *P. pratensis*, where over half the larvae were referable to *Oscinella frit* (L.), including the form from oats, the one from *Arrhenatherum* [*cf. R.A.E.*, A **47** 166] and one differing from either. Larval densities in both *L. perenne* and *D. glomerata* varied considerably. The larvae showed preferences for specific grasses, and this preference appeared to be of greater importance than date of mowing in determining infestation. *O. frit* was most numerous in *P. pratensis*, somewhat less so in *L. perenne*, and virtually absent from *D. glomerata*; populations in *Agrostis tenuis*, which is normally preferred, were greatly reduced in 1956, when the stand was poor and the proportion of stem to leaf relatively high. *Geomyza tripunctata* Fall. [*cf.* **26** 382] occurred consistently and usually abundantly in *L. perenne*, but was relatively rare in 1956, when growth of this grass was poor. *Meromyza saltatrix* (L.) [*cf.* **30** 405] was almost confined to *P. pratensis*. A species of *Cetema* tentatively identified as *C. neglecta* Tonnoir normally attacks *A. tenuis* and was common in one locality but not in the other; it had recently affected the growth of young wheat elsewhere in Berkshire.

The larval populations of the leys were reflected in the populations in winter wheat that followed them. In 1956, populations of up to 65 larvae per sq. yard, mostly *O. frit* but including a few Halticids and Noctuids, were found in the wheat in March, and plant mortality was high. Infestation was heaviest in wheat that followed *L. perenne*, and decreased progressively in wheat following *P. pratensis*, *F. rubra*, *A. tenuis* and *F. arundinacea*. *O. frit* was virtually absent from wheat following *D. glomerata*. Although *G. tripunctata* and *M. saltatrix*, as well as *M. variegata* Mg. and *O. vastatrix* (Curt.), were quite abundant in the leys, they showed little tendency to migrate to the wheat. *Opomyza florum* (F.) [*cf.* **22** 1], which was frequent in wheat in 1954 and 1955, was not present in the leys. The species of *Cetema* occurred in wheat following *P. pratensis* and *L. perenne*, as well as in that following *A. tenuis*.

The results of other studies in progress demonstrated significantly greater survival and, less consistently, significantly higher production of fertile tillers in wheat following leys of *D. glomerata* than of *L. perenne* and indicate a direct relation between larval populations and the number of wheat plants surviving into May. In 1956, the mean yields of wheat following grazed and hay leys of *F. arundinacea* and *D. glomerata* differed by 8 and 15 cwt. per acre, respectively, whereas the difference was only 1–6 cwt. per acre for the other grasses. The substitution of *D. glomerata* and, possibly, *F. arundinacea*, for more susceptible species in leys and headlands might be of value in reducing damage by *Oscinella frit* in districts in which grass leys or winter cereals frequently fail to become established.

COLLYER (E.) & KIRBY (A. H. M.). **Further Studies on the Influence of Fungicide Sprays on the Balance of phytophagous and predacious Mites on Apple in south-east England.**—*J. hort. Sci.* **34** no. 1 pp. 39–50, 3 graphs, 12 refs. London, 1959.

In experiments on apple in south-eastern England in 1951–53, higher populations of *Panonychus ulmi* (Koch) developed on plots sprayed with lime-sulphur as the fungicide than on those sprayed with glyodin (2-heptadecyl-2-imidazoline acetate) or captan (N-(trichloromethylthio)-4-cyclohexene-1,2-dicarboximide); wettable sulphur gave an intermediate result. Populations of predacious insects were little affected by any of the fungicides, but predacious mites (*Typhlodromus* spp.) were more numerous on trees sprayed with glyodin or captan than on those receiving lime-sulphur and seemed to be responsible for the reduced infestation by *P. ulmi* on the former [*cf.* *R.A.E.*, A **47** 306]. The plots were small, however, and the trees close together, and a large-scale test was therefore made in 1952–56. Four spray applications were made each season, consisting of lime-sulphur at 2·5 and 2 per cent. in the pre-blossom sprays and at 1 and 0·75 per cent. in the post-blossom sprays each year, captan at 0·1 per cent. each year, or glyodin at 0·075 per cent. in 1952, lime-sulphur at 2·5 and 2 per cent. in the pre-blossom sprays and captan at 0·1 per cent. in the post-blossom ones in 1953–55, and DNOPC (2,4-dinitro-6-(1-methylheptyl)phenyl crotonate) at 0·025 per cent. in 1956. The only insecticides used were nicotine and lead arsenate, with bud-burst applications of DDT in 1953 and 1955. The following is based on the authors' summary of the results.

The numbers of *P. ulmi* remained below one per leaf on all trees in 1952 and exceeded this level on trees receiving lime-sulphur, even in pre-blossom sprays only, in all subsequent years, causing bronzing in 1955, but seldom exceeded it on those receiving captan only. *T. tiliae* Oudm. was always more numerous on the trees treated with captan only than on the others, and tended to be slightly less numerous in 1954–55 on trees receiving the mixed schedule than on those treated with lime-sulphur only. The numbers showed a marked inverse correlation with those of *P. ulmi*, the ratio of *P. ulmi* to *T. tiliae* frequently exceeding 10:1 on the lime-sulphur plots, which never occurred on those receiving captan.

Predacious insects of one or more species were abundant each season. *Anthocoris* spp. and *Orius majusculus* (Reut.) alternated between and within seasons, and *Blepharidopterus angulatus* (Fall.) increased each year, but tended to be less numerous on trees treated with the mixed schedule than on those sprayed with lime-sulphur or captan. Other predacious

Mirids were abundant at the beginning of the experiment, but were adversely affected by lime-sulphur and DDT and became negligible by 1955. Insect predators showed no numerical correlation, either individually or collectively, with *P. ulmi*, but this might have been due to the presence of other prey species.

The results of the two series of experiments suggest that *Typhlodromus* mites are important predators of *P. ulmi* in south-eastern England, and that the use of captan as a fungicide permits natural control of the latter at an economic level.

Chant (D. A.). **Immature and Adult Stages of some British Phytoseiidae Berl., 1916 (Acarina).**—*J. Linn. Soc.* (*Zool.*) **43** no. 294 pp. 599–643, 26 figs., 27 refs. London, 1958. **Observations sur la famille des Phytoseiidae.**—*Acarologia* **1** fasc. 1 pp. 11–22, 1 pl., 39 refs. La Varenne, 1959.

In the first of these papers, the author states that a study of mixed populations of Phytoseiid mites in south-eastern England in 1952–55 was hampered by difficulty in differentiating the species in their immature stages. He therefore describes and figures the larvae, protonymphs, deutonymphs and adults of both sexes of 18 species found, giving only characters of taxonomic value and omitting the eggs because their dimensions alter during development, and gives keys to them based on all these stages, followed by some discussion of relationships. Almost all of them belong to the genus *Typhlodromus*.

In the second paper, he discusses the ecology, economic importance and taxonomy of Phytoseiids, which prey on phytophagous mites and insects and are affected by chemical treatments applied against the latter. They are widely distributed throughout the world, on fruit trees and other plants, and most have few generations a year, though development is completed in a few days. *Typhlodromus tiliae* Oudm., which has been studied in south-eastern England, has three and a partial fourth; notes on its habits are given.

Schvester (D.) & Rives (M.). **Nouveaux résultats d'essais de traitements sur haricots contre la mouche des semis** *Hylemyia cilicrura* **Rond.**—*Phytiat.-Phytopharm.* **7** no. 1 pp. 21–28, 1 graph. Paris, 1958.

In continuation of earlier tests in France [*R.A.E.*, A **47** 8], the value of coating haricot-bean seeds with insecticides alone and in combination with a fungicide (thiram [bis(dimethylthiocarbamoyl) disulphide]) for field protection against *Hylemyia cilicrura* (Rond.) was further investigated in two plot tests in the Gironde in March–May 1957. The chemicals were in the form of wettable powders containing 25 per cent. aldrin, 30 per cent. lindane [almost pure γ BHC] and 75 per cent. thiram, and these were used at 0·1, 0·08 and 0·08 per cent. by weight of seed, respectively, with 2 per cent. methylcellulose as an adhesive.

In the first test, treatment with the insecticides alone resulted in decreases in the numbers of plants in one series and in increases in the other, whereas the fungicide alone increased them in both, as compared with no treatment; greater increases in both series resulted from combined treatment with insecticide and fungicide, γ BHC being superior to aldrin. The insecticides alone were about equally effective in protecting the plants obtained from being destroyed by *H. cilicrura*, and addition of the fungicide had little effect on this in the first series, but aldrin was more effective than γ BHC and addition of the fungicide decreased its effectiveness but increased that of γ BHC in the second series. Aldrin seemed slightly less effective against the larvae than γ BHC and permitted some superficial feeding on the cotyledons and leaves, though this was of little importance. The combination of γ BHC with thiram resulted in most plants and least damage in both series.

In the second test, in which injury by the larvae was negligible, the percentages of plants obtained were 50·7 and 38 for aldrin and γ BHC alone, 91·7 and 84·2 for these with thiram, 94·2 for thiram alone and 79·9 for no treatment. The unfavourable effect of the insecticides used alone was unexplained, but is thought to have been associated with abundance of soil fungi.

When the treated seed was stored for up to six months, the insecticides and fungicide slightly reduced germination when used alone, but not when combined.

Schvester (D.). **Essais comparatifs du malathion et du lindane pour la protection des stocks de haricots grains contre la bruche** *Acanthoscelides obsoletus* **Say.**—*Phytiat.-Phytopharm.* 7 no. 1 pp. 29–38, 3 refs. Paris, 1958.

The effectiveness of lindane [almost pure γ BHC] and malathion in preventing infestation of stored haricot beans by *Acanthoscelides obtectus* (Say) (*obsoletus*, auct.) was assessed in France in 1956–57. Uninfested beans were treated on 20th September with dusts of γ BHC to give 1, 2, 3 and 5 parts toxicant per million of seed, and of malathion to give 2·5, 5 and 10 p.p.m., and 100-g. samples from each treatment were then stored in plastic boxes with transparent lids under two sets of conditions. Half of them were kept in a dark chamber at 25–26°C. [77–78·8°F.], which was considered to provide a favourable environment for *A. obtectus*, and the others were stored in a basement where the temperature was variable, but was higher in winter and lower in summer than were the outside temperatures, and conditions were less favourable for the Bruchid. On the day after treatment and at monthly intervals thereafter, two samples for each treatment and two untreated samples were infested with 100 freshly-emerged adults; half the samples were then examined daily for mortality of these, and the others were left untouched so that the eventual degree of infestation could be measured.

The results of the tests carried out in the basement were inconclusive, as maximum temperatures between 20th October and 20th February never exceeded 15°C. [59°F.] and the rate of reproduction of *A. obtectus* was consequently low, although oviposition never ceased entirely. They did, however, indicate the value of that type of storage. The number of days of exposure required for 100 per cent. mortality of the introduced adults on beans treated with γ BHC at 2–5 p.p.m. ranged from 1–2 immediately after treatment to 31–33 after storage for six months; at 1 p.p.m., the period required was 45 days after three months. With malathion at 5 and 10 p.p.m., the number of days ranged from 4 and 2 immediately after treatment to 52 and 26 after six months, and at 2·5 p.p.m. it was 14 after one month. With the beans stored at 25–26°C., 100 per cent. mortality was given by γ BHC at 1 p.p.m. in 2 days immediately after treatment and in 14 days after storage for three months; at 5 p.p.m., the intervals were 2, 9 and 13 days immediately after storage and after 3 and 8 months, respectively. For malathion, the periods were 12 days after a month at 2·5 p.p.m. and 10 days after 6 and 7 months at 5 and 10 p.p.m., respectively. Counts of the adults that developed in the other series of samples kept at

25–26°C. showed that the effectiveness of $\gamma$ BHC in preventing infestation increased with the rate of application, very few of the $F_1$ and none of the $F_2$ generation developing in beans treated at 5 p.p.m. and stored for up to a year. Complete protection was maintained by $\gamma$ BHC at 1 p.p.m. for two months, at 2 p.p.m. for three months, and at 3 p.p.m. for six months. Malathion gave complete protection for four months at 5 and 10 p.p.m., but was insufficient at 2·5 p.p.m.

The action of the insecticides on the immature stages was investigated in October 1956 by treating already infested beans, storing them as before and counting the adults that emerged from them and from untreated samples. Malathion had no effect, and although $\gamma$ BHC at 3 and 5 p.p.m. progressively reduced the numbers, examination showed that development of the insects had proceeded normally up to the time of adult emergence, so that damage to the beans was not reduced.

None of the treatments had any adverse effect on germination of the beans.

Anglade (P.). **Essais insecticides de plein champ contre les larves de taupins** (*Agriotes* **sp.**) **nuisibles au maïs dans le Sud-ouest.**—*Phytiat.-Phytopharm.* **7** no. 1 pp. 39–46, 6 refs. Paris, 1958.

As earlier tests with parathion, which was as effective at 3·5 oz. per 500 yards of row as BHC at 9 lb. per acre, had indicated the practicability of restricting soil treatments with insecticides against wireworms (*Agriotes* sp.) attacking maize to the seed row instead of applying them to the entire field, further tests with row applications were made in 1957 at various places in south-western France, in which the wireworm populations varied considerably in size. Sowing and treatment were carried out simultaneously in the second half of May by using drills that placed insecticide dusts either above or on each side of the seed in the furrows, and by using a sprayer that discharged a narrow band at a rate of about 2 gal. per 500 yards and the results were assessed in the final weeks of June and July. Aldrin and heptachlor dusts gave good protection at rates of about 2·75 and 1·75 oz. toxicant per 500 yards, respectively, as also did liquid formulations of these materials at about 1·6 oz., but chlordane at about 3 and 2·75 oz. toxicant per 500 yards in a dust was less effective. A dust of parathion at 2·75 oz., which was included at one place, proved satisfactory. The homogeneity of the formulation and even distribution were of greater importance than the choice of insecticide, especially with dusts.

In a subsidiary test of complete soil treatment, aldrin at 3·6 lb., heptachlor at 3·2 lb. and chlordane at 6·3 lb. per acre, applied on 8th March, reduced the attack on oats sown two days later to 14·31, 22·76 and 27·93 per cent., respectively, by the fourth week of April.

Coating maize seeds with 40 per cent. wettable aldrin at 7 oz. and 20 per cent. wettable heptachlor at 7 and 14 oz. per cwt., with the addition of a fungicide (thiram [bis(dimethylthiocarbamoyl) disulphide]) and methylcellulose as an adhesive, did not provide significant protection.

It is concluded that row treatments are satisfactory, even under conditions of heavy infestation.

Murbach (R.). **Le colza de la Plaine du Rhône attaqué par un charançon peu connu:** *Ceuthorrhynchus picitarsis* **Gyll.** (**Col., Curcul.**).—*Rev. rom. Agric.* **14** no. 10 pp. 80–81, 3 figs., 4 refs. Lausanne, 1958.

*Ceutorhynchus picitarsis* Gylh., which had not previously been of importance in Switzerland, was observed attacking rape in the south-east of the canton of Vaud in April 1958. A short account is given, based on the literature [*cf. R.A.E.*, A **29** 235; **42** 108], of the life-history of this weevil, the damage it causes and its control.

Savary (A.) & Baggiolini (M.). **La lutte contre la pyrale de la vigne** (*Sparganothis pilleriana* Schiff.) **dans les cultures de fraises.**—*Rev. rom. Agric.* **14** no. 10 pp. 81–83, 3 figs., 1 ref. Lausanne, 1958.

Observations in the Swiss canton of Valais in 1957–58 showed that attack by *Sparganothis pilleriana* (Schiff.) on strawberry was spreading [*cf. R.A.E.*, A **46** 77]. Investigations on control were made in 1957, and surveys on 5th June indicated that spraying the plants thoroughly on 22nd April, just before flowering began, was more effective than spraying or broadcasting the insecticide on 2nd April, at the beginning of the growing season, though emulsion sprays containing 0·6 lb. diazinon [O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl phosphorothioate], 0·2 lb. parathion or a mixture of 0·6 lb. malathion and 0·5 lb. Perthane [1,1-di(p-ethylphenyl)-2,2-dichloroethane (ethyl-DDD)] per 100 gal., applied on either date, and 2·5 per cent. parathion broadcast at 3·375 lb. active compound per acre on the first of them, all gave excellent control, whereas 0·2 lb. diazinon per 100 gal. gave relatively poor results. DDT also gave good control, but both it and the parathion spray increased infestation by *Tetranychus telarius* (L.) (*urticae* Koch) and *Panonychus* (*Metatetranychus*) *ulmi* (Koch) at harvest. It is concluded that sprays containing high concentrations of diazinon should be applied to wet the plants thoroughly just before flowering.

Schütte (F.). **Untersuchungen über die Populationsdynamik des Eichenwicklers** (*Tortrix viridana* **L.**). **Teil I.** [Investigations on the Population Dynamics of *T. viridana*. Part I.]—*Z. angew. Ent.* **40** pt. 1 pp. 1–36, 28 figs. Hamburg, 1957. **Teil II.** [Part II.]—*T. c.* pt. 3 pp. 285–331, 19 figs., 3 pp. refs. (With a Summary in English.)

Oak forests in Westphalia are infested almost every year by *Tortrix viridana* (L.), but the amount of damage caused varies from season to season and from place to place [*cf. R.A.E.*, A **28** 56]. Investigations on the factors responsible for changes in the population of the Tortricid were made in 1950–53 near Münster in the laboratory and in four forest stands of which one consisted almost entirely of oak, two were of oak and hornbeam (differing in that nesting boxes and winter food were provided for birds in the second of them), and the last was of oak and spruce. The population of *T. viridana* rose to a peak in the first and last of these in 1951 and was still relatively high in the other two, in which a peak had been reached earlier. It became generally low in all stands by 1952 or 1953, the population falling from the maximum recorded by some 50–93 per cent.

The maximum number of eggs laid per female in the laboratory was 84 and the average 65, and the number was reduced by 7–56 per cent. when the percentage of females in the population rose above 50, owing to overcrowding in the larval stage and resulting lack of food. Egg mortality, the causes of which were unknown, averaged 9 per cent. Mortality from various causes in the later stages is shown on a diagram as proportions of the original egg population, and mortality of larvae during hatching, calculated in this way, amounted to about 2–10 per cent.

The young larvae fed only on oak, but older ones unable to find food moved to other trees. Oak was attacked at the earliest when the buds were beginning to burst, but usually not until they were already open. In 1952, the buds on the different trees opened between 11th and 30th April and the larvae hatched between 13th and 20th April, so that a proportion of the young larvae died before the tree on which they hatched reached the required stage. Larval hatching coincided with the opening of the buds on late oaks in 1951, on early ones in 1952 and on both in 1953. Mortality resulting from lack of coincidence represented about 35–80 per cent. of the original egg population. Temperature appeared to be the principal factor responsible for non-coincidence. Frequent wide variation in temperature in the laboratory was shown to hasten or delay hatching by as much as 10–11 days in relation to bud development, and whereas the larvae, but not the buds, were able to withstand temperatures falling as low as –5°C. [23°F.], only the buds could withstand a temperature rising as high as 40°C. [104°F.]. Larval mortality increased with the numbers of eggs laid, but mortality due to overpopulation was conspicuous only in 1952, when it reached about 8–16 per cent. of the original egg population.

The larvae and pupae were attacked by parasites, mainly Ichneumonids and Tachinids. The most important of the former were *Itoplectis maculator* (F.), *Apechthis rufata* (Gmel.) and *Phaeogenes invisor* (Thnb.), and the Tachinids were almost all *Elodia tragica* (Mg.). Larval mortality caused by them rose from 0 and 3 per cent. in 1950 to 2–5 and 8–27 per cent. in 1953, respectively, and pupal mortality due to parasitism rose from 7 and 2 per cent., respectively, in 1950 to 35–52 and 2–3 per cent. in 1952, and was 5–39 and 0–6 per cent., respectively, in 1953. Over-all mortality of larvae and pupae as a result of parasitism represented about 0–7 and 0–6 per cent., respectively, of the original egg population. *E. tragica* was mostly found attacking the older larvae, and since the female host larvae not only have a longer feeding period than the males but also take more food and thus ingest more eggs of this parasite, more of them became parasitised by it. The Ichneumonids coincided predominantly with early pupating hosts, which were preponderantly male. Mortality due to disturbances at pupation, drying out of the larvae and larval disease reached 8–17, 2 and 2–5 per cent., respectively, the first two in 1952 and the third in 1953, and mortality from these causes together represented about 0–3 per cent. of the original egg population. That due to disease and drying out of the pupae reached 8–13 and 1–6 per cent., respectively, in 1952, and accounted for about 0–4 per cent. of the egg population.

Larvae, pupae and adults were attacked by various insect predators, of which Carabids were the most important, and the larvae and pupae by larvae of *Enarmonia isertana* (F.) (*Epinotia corticana* (Hb.)), which were of some importance in 1953. Mass increase in numbers of insect predators generally followed a year behind that of *T. viridana*. Birds fed on all stages except the egg, but they also attacked natural enemies, and comparison of the two similar stands with and without nesting boxes showed that the control afforded by birds was largely offset by higher mortality due to overcrowding and greater survival of natural enemies when birds were less common. The numbers of larvae, pupae and adults destroyed by all the predators represented about 1–14, 0–7 and 0–7 per cent., respectively, of the original egg population, and total mortality of all the immature stages was about 65–99 per cent. The relative importance of the various mortality factors in the four stands is discussed in detail, and it is concluded that the non-coincidence of larval hatching and bud opening is of major importance in determining the changes of population of *T. viridana*. Natural enemies were most consistently effective and the population of *T. viridana* lowest and most constant in the stand consisting only of oaks, in which the lack of coincidence between bud opening and larval hatching was similar in extent each year. The planting of late-leafing oaks appears to be a desirable protective measure.

Heddergott (H.). *Cnephasia argentana* **Cl. (Lep., Tortricidae) als Schädling an Fichtenkulturen.** [*Eana argentana* as a Pest in Spruce Plantations.] —*Z. angew. Ent.* **40** pt. 3 pp. 332–342, 7 figs., 71 refs. Hamburg, 1957. (With a Summary in English.)

Larvae causing defoliation of spruce in a newly established plantation near Münster in late May 1954 were identified from the adults that emerged as *Eana* (*Cnephasia*) *argentana* (Cl.), a Tortricid seldom reported in northern Germany of which the bionomics were unknown. Its synonymy and world distribution are reviewed, and all stages are briefly described. Earlier references to it are from grassland. Investigations showed that the plantation was situated in a forest clearing that had been under grass not cut for three years, and the ground had not been ploughed before the young trees were planted earlier in the month. Numerous weeds were present. Defoliation of the trees was severe, but the larvae had been destroyed by a parathion spray. In May 1955, the trees had been sprayed with a game repellent and were not infested, but larvae were numerous in the ground cover, which was severely damaged. Larvae transferred to an insectary mostly gave rise to adults by the end of June, and some were used for laboratory investigations on the bionomics of the moth. The pupal stage lasted 15–16 days at 18–20°C. [64·4–68°F.], and the adults emerged mainly from mid-June to mid-July. They paired within a day or two, and the females oviposited within 5–10 days, laying about 150 eggs each in several batches on grasses and weeds affording a rough surface. The larvae hatched in 10–11 days at 18–20°C. and spun webs between soil particles, in which they overwintered. They fed only in the following spring, and pupated in webbing in late May or early June. The reason for the attack on spruce was not clear, since there was no shortage of their usual food-plants. Low parasitism in 1953–54 appeared to have been mainly responsible for the great increase in population.

Wichmann (H. E.). **Untersuchungen an** *Ips typographus* **L. und seiner Umwelt.** [Investigations on *I. typographus* and its Environment.]—*Z. angew. Ent.* **40** pt. 3 pp. 433–440, 20 refs. Hamburg, 1957. (With a Summary in English.)

Raphidiid larvae are the most powerful of the predators that attack insects associated with the bark of spruce, and they have occasionally been recorded as attacking bark-beetles. Investigations carried out in southern Bavaria to find whether any part was played by *Raphidia notata* F. and *R. flavipes* Stein in the control of *Ips typographus* (L.) suggested that the larvae of the two species are non-specific predators confined to the surface of the trunks or to ground litter. They did not spontaneously enter occupied bark-beetle galleries, although they sometimes overwintered in unoccupied ones. The adults of many small Scolytids were attacked by them in the laboratory, but the smooth, rounded body of *I. typographus* made it difficult to capture, and the chances of an adult's being attacked in the short time during which it is entering a tree or descending the trunk to overwinter are considered slight. The larva did, however, destroy large numbers of the eggs of *Thanasimus formicarius* (L.) and *Medetera* spp., which attack Scolytids. The adults of *Raphidia* are unlikely to afford much control, since they occur mainly in undergrowth in thin or cleared forest.

Tinnilä (A.). **On the Influence of Freezing upon some Plant Protection Chemicals.**—*Maataloust. Aikakausk.* **30** pp. 209–210. Helsinki, 1958.

Experiments in Finland, in which various insecticides were stored in the open, protected only against rain, between 15th November 1956 and 30th

April 1957, when maximum, minimum and average temperatures were 16·9, −30·2 and −2·7°C. [62·42, −22·36 and 27·14°F.], respectively, showed that dusts became lumpy and unusable and that a concentrate of DNC in oil separated into its components, a yellow precipitate being formed; both dusts and sprays clogged apparatus. When the materials were tested in the laboratory in comparison with samples that had been stored under dry conditions at 17°C. [62·6°F.], the effectiveness of emulsion sprays containing a mixture of mineral oil and tar distillate (3:5) against winter eggs of *Panonychus ulmi* (Koch) (*Metatetranychus pilosus* (C. & F.)) and *Psylla mali* (Schmidb.) and of sprays of parathion or malathion (from emulsion concentrates) against larvae of *Athalia rosae* (L.) (*colibri* (Christ)) was not reduced by freezing.

VARIS (A. L.). **On the Importance of the Sowing Time of Crucifers in preventing the Damage caused by Cabbage Maggots** (*Hylemyia* **spp.), on the Basis of Tests made on Big-leafed Turnip.**—*Maataloust. Aikakausk.* **30** pp. 264–270, 4 refs. Helsinki, 1958. **On the Susceptibility of the different Varieties of Big-leafed Turnip to Damage caused by Cabbage Maggots** (*Hylemyia* **spp.).**—*T. c.* pp. 271–275, 5 refs. (With Summaries in Finnish.)

The first of these papers contains accounts of experiments carried out in two localities, one in southern and one in northern Finland, on the effect of sowing time on the infestation of turnip by species of *Hylemyia*. Preliminary observations on cabbage or swede in the south in 1941 and 1945–49 showed that oviposition continued from late May or early June until early September, reaching a peak in June, for *H. brassicae* (Bch.) and in July–August for *H. floralis* (Fall.); there was also oviposition by a further generation of *H. brassicae* and by less important species. Turnip sown in the south on 3–5 different dates in May–July in 1950–55 were examined for injury in August–October, and those sown in the north on 3–5 dates in May–June in 1951–53 were examined in August–September. It was found that the date of sowing affected the abundance and severity of damage, but that in southern Finland, where sowing times could more easily be varied because of the longer summer, ovipositing females are present throughout the season and differences in weather conditions and in the predominance of different species affected the results so much that favourable sowing dates could not be estimated in advance. In northern Finland, where *H. brassicae* and *H. floralis* seem to occur together and for a shorter period, plants that were sown early tended to be more severely damaged than later ones, but postponement of sowing time had a detrimental effect on growth and reduced the yield.

The second paper contains the results of experiments in which several varieties of turnip were tested for susceptibility to *Hylemyia* spp.

TADIĆ (M.). **Jabučni smotovac** (*Carpocapsa pomonella* **L.). Biologia kao osnova za njegovo suzbijanje.** [The Bionomics of *Cydia pomonella* as a Basis for its Control.]—*Mem. Inst. Pl. Prot.* no. 4, 100 pp., 10 pls., 7 figs., 135 refs. Belgrade, 1957. (With a Summary in English.)

*Cydia* (*Carpocapsa*) *pomonella* (L.), of which all stages are described, destroys up to 90 per cent. of the apple crop in Yugoslavia, and investigations on its bionomics and control [*cf. R.A.E.*, A **41** 104] were made in 1950–53. There were two overlapping generations a year. They were about equally numerous, but larvae of the second, which attack almost ripe fruits, cause greater losses than those of the first. The adults of the overwintered generation emerged from late April to mid-July and those of the first from late June to the end of August, and the total flight period of both generations averaged 112 days. Males emerged first, but were slightly less numerous than females. Females of the overwintered generation oviposited on the leaves and twigs, and those of the first generation on the fruits. The larvae hatched in 5·8–7·5 days, and in choosing a place to enter the fruit, avoided direct sunlight and preferred the site of an existing injury. Of 1,503 infested fruits, about 42 per cent. had been entered near the stalk, 11 per cent. near the calyx and 47 per cent. on the side. Field observations in 1950 showed that the period from adult emergence to the entering of fruit by the larvae averaged 12·6 days in May, 9·2 in June, 7·7 in July and 8·6 in August. Similar observations should be made in all fruit-growing regions to determine the best time for spraying. Of 862 first-generation larvae observed in 1950 and 664 in 1952, 5·3 and 2·7 per cent., respectively, entered diapause, but gave rise to the normal two generations in the following year. No larvae remained in diapause over two winters.

The eggs of *C. pomonella* were parasitised by *Trichogramma evanescens* Westw., and the larvae were parasitised by a species of *Ephialtes* referred to as *E. extensor* Tasch. [which is a synonym of *E. punctulatus* (Ratz.) (*cf.* **28** 226; **33** 356)] and by *Pristomerus vulnerator* (Panz.), *Trichomma enecator* (Rossi), *Ascogaster* sp. and *Pimpla turionellae* (L.) (*examinator* (F.) ), which last also attacked the pupae. Hyperparasites observed were *Perilampus tristis* Mayr, *Dibrachys decedens* (Wlk.) and *Ascogaster* sp. Predators included ants and woodpeckers. The fungus, *Beauveria bassiana*, infested the larvae and pupae, particularly in wet weather, and this, together with the fact that rain washes newly hatched larvae from the trees and that the wings of adults in flight adhere to wet leaves, may account for less serious infestation by *C. pomonella* in rainy years. In tests of sprays, a DDT preparation (Pantakan) gave good control of eggs, larvae and adults, but rapidly lost its effectiveness. Lead arsenate was less effective, but retained its toxicity to the larvae longer. The author recommends the use of trap bands [*cf.* **41** 297] and of net traps, which last longer and give as good results. These consist of bands of corrugated paper covered with wire gauze placed round the trunks of the trees. The larvae enter them to hibernate and pupate, and the adults on emergence cannot escape. Such traps last for at least two years.

BJEGOVIĆ (P.). **Žitni bauljar** (*Zabrus tenebrioides* **Goeze**) **i njegova parazitska muva** (*Viviania cinerea* **Fall.**). [*Z. tenebrioides* and its Parasite (*V. cinerea*).]—*Mem. Inst. Pl. Prot.* no. 5, 104 pp., 9 pls., 16 figs., 88 refs. Belgrade, 1957. (With a Summary in English.)

Serious attacks by *Zabrus tenebrioides* (Goeze) occurred on winter cereals in the Vojvodina, Serbia and eastern Croatia in 1947–52 [*cf. R.A.E.*, A **41** 297], during which period 18,251 acres of wheat, barley and rye were destroyed, and investigations on the bionomics and control of the Carabid were begun in 1949. Most of the damage is caused by the larvae, which are described, and up to 293 were observed in sample areas of 0·25 sq. m. Oviposition began as early as August, the date depending on sufficient soil humidity, and the eggs were laid singly in small chambers in the upper 7 in. of soil, at an average rate of 40–80 per female. The oviposition period is extended because the eggs are not all matured at the same time. The larvae hatched in 8–17 days, or longer at temperatures below 16°C. [60·8°F.]. Those that appeared before the germination of cereal crops survived for

30–50 days without food, but those that hatched in August usually succumbed. Feeding and development began towards the end of September, and the larval stage lasted up to 7·5 months in the field, but averaged 86 days at a constant temperature of 18°C. [64·4°F.] in the laboratory. Most of the larvae overwintered in the first or second instar, ceasing to feed but continuing to moult. They did not enter diapause and were killed by temperatures below 0°C. [32°F.] or above 27°C. [80·6°F.]. The larvae pupated in April or May in oval chambers in the soil, and the pupal stage lasted 12–20 days, depending on temperature, averaging 18 days at 18°C. and 12 days at 23°C. [73·4°F.]. On emergence, the adults came to the surface and fed at night on wheat grains in the milky stage of ripeness until mid-June, when they ceased feeding and dispersed to other grain fields. Maturation feeding then took place, followed by an aestivation period lasting 1·5–3 months, during which the reproductive organs matured. Pairing occurred during August–September.

To prevent infestation, cereals should be harvested as early as possible and the stubble ploughed in immediately afterwards. Consecutive sowings of susceptible crops on the same plot should be avoided, and spring-sown crops are preferable to autumn-sown ones. Sprays of parathion and dusts of BHC gave good control of the larvae. Calcium arsenate in sprays was also effective, and superior to lead arsenate or nicotine. Treatment should be applied only when over 90 per cent. of the larvae are feeding, and two applications, 10–15 days apart, are recommended.

The Tachinid, *Viviania cinerea* (Fall.), is an important parasite of *Z. tenebrioides*, and also parasitises other Carabids. The eggs were laid on the ventral surface of the abdomen or sometimes on the femora of the hind legs of the adults during the flight period, and the larvae hatched immediately and passed through the underside of the egg-shell into the body of the host. Only one developed per host. It became attached to a trachea and formed a respiratory funnel. The larval stage lasted ten months. In the second instar, the larva underwent a nine-month diapause, and the host entered a compulsory diapause for the same period. Before pupating, towards the end of April, the larva became detached from the trachea and underwent a period of intense feeding. The pupal stage lasted 16–18 days at 20–21°C. [68–69·8°C.], and the adults lived for 29–36 days after emerging from the host. Females laid an average of 100 eggs each. In one area, 41 per cent. of the adults of *Z. tenebrioides* were parasitised in 1950, and 34 per cent. in 1951.

Sandner (H.). **Wyniki wstępnych badań nad stosunkiem do pokarmu wołka ryżowego** (*Sitophilus oryzae* **L.**). [Results of preliminary Research on the Relation of the Rice Weevil (*Calandra oryzae*) to its Food.]—*Ekol. polska* (B) **4** pt. 2 pp. 155–161, 2 graphs. Warsaw, 1958. (With a Summary in English.)

The following is based on the author's summary. Experiments were carried out in May–December 1957 to determine the effect of various types of grain on the population increase of *Calandra* (*Sitophilus*) *oryzae* (L.) and to find which the females preferred for oviposition. Known numbers of adult weevils were introduced into weighed samples of wheat, rye, rice, pearl barley, oats and barley, alone or mixed, and later removed, and their offspring were counted after 2·5 months and at intervals thereafter. It is concluded from the results that pearl barley was the most favourable food, the females preferring it for oviposition and the larvae developing in it in the shortest time. The quality of rice affected its suitability, and unhusked oats were not infested.

Sandner (H.). **Wpływ zagęszczenia populacji na płodność wołka zbożowego** (*Calandra granaria* **L.**) **i wołka ryżowego** (*Sitophilus oryzae* **L.**). [Influence of Population Density on the Fertility of the Grain Weevil (*Calandra granaria*) and the Rice Weevil (*C. oryzae*).]—*Ekol. polska* (B) **4** pt. 4 pp. 293–298, 2 graphs, 2 refs. Warsaw, 1958. (With a Summary in English.)

The following is based on the author's summary. Experiments are described in which batches of 20–400 adults of *Calandra granaria* (L.) and *C.* (*Sitophilus*) *oryzae* (L.) were introduced into vessels each containing 50 g. rye kept at 30°C. [86°F.] and about 85 per cent. relative humidity. The original adults were removed after 25 days and those of the next generation daily as they emerged. The numbers of the latter reached their maximum when the numbers of adults originally introduced were 80 and 120 in two tests with *C. granaria* and when they were 40 and 120 in two with *C. oryzae*, and then decreased. The two species showed great individual variations in the duration of development. The greater the number of individuals in the original sample, the shorter the period over which the adults of the next generation emerged.

Norris (M. J.) (Mrs. O. W. Richards). **Influence of Photoperiod on imaginal Diapause in Acridids.**—*Nature* **181** no. 4601 p. 58, 4 refs. London, 1958.

Adults of *Nomadacris septemfasciata* (Serv.) in the Rukwa Valley of Tanganyika, between 7 and 9°S. lat., emerge in March or April and enter diapause for a period of 8–9 months, after which the females oviposit during the rains in November and December. Hamilton reared this species at high temperature through several generations and found that diapause was eliminated in adults of the first generation but not of succeeding ones [*cf.* *R.A.E.*, A **24** 229]. When the locusts were reared at constant temperature and humidity in a room with unscreened windows in London over a period of three years, those that emerged in spring and summer became sexually mature in 5–10 weeks, whereas those that emerged after the end of July or the middle of August did not mature until the following March or April, the incidence of diapause depending on season and not on generation [*cf.* **47** 11]. When adults were allowed to emerge in artificially lit cabinets in which the daily photoperiod was gradually increased or decreased to simulate spring and autumn conditions, respectively, they showed maturation periods appropriate to the artificial season, and those that appeared when the photoperiod had increased to 11½ hours, as in mid-March, matured in 69 days, whereas those that appeared when it had decreased to 12½ hours, as in mid-September, required 223 days. In this way, continuous breeding without diapause was maintained for two years. In the field, lengthening days are not required for the termination of diapause in spring, for the period is not affected if the locusts are deprived of the extra hours of daylight after the shortest day. At the northern end of the Rukwa Valley, the length of day varies throughout the year by only 50 minutes and decreases most rapidly (by 14 minutes during March) when the adults are appearing. Photoperiods changing by such small amounts could not be reproduced, but photoperiods of constant duration were found in preliminary experiments to be less effective in establishing prolonged diapause than decreasing ones. Adults subjected to constant daily photoperiods of 8, 11 and 13½ hours matured in 163, 154 and 78 days, respectively. It appears from this that the period of daylight critical for maturation lies between 11 and 13½ hours, and since day length in the natural habitat varies from about 11½ to 12½ hours, it may be the factor responsible for the diapause.

Adults of *Anacridium aegyptium* (L.), which emerge in July and August but do not oviposit till the following spring in their natural habitat in the Mediterranean region, also enter diapause in a constant laboratory environment, those that appear in spring maturing in 7–12 weeks and those that appear after the end of May usually doing so in January, February or March. Adults that emerge in summer can be induced to enter diapause by subjecting them to increasing day length. Since field adults enter diapause so early in the year, it is concluded that rapid maturation is inhibited by long summer days and by decreasing day length.

Bünzli (G. H.) & Büttiker (W. W.). **Insects in Southern Rhodesian Tobacco Culture. Part I. Insects occurring in Seed-beds.**—*Acta trop.* **13** no. 4 pp. 352–365, 43 refs. Basle, 1956. **Part II. Insects occurring in the Fields. Hymenoptera.**—*Op. cit.* **14** no. 3 pp. 236–243, 32 refs. 1957. **Part III. Insects occurring in the Fields. Diptera.**—*T. c.* pp. 243–250, 42 refs. **Part IV. Insects occurring in the Fields. Tenebrionidae and Elateridae.**—*T. c.* pp. 250–253, 6 refs.

These are the first parts of a continuing series comprising lists of the insects and a few other invertebrates found associated with tobacco in seed-beds and fields in Southern Rhodesia in 1949–52, with notes on their abundance and importance. The insects include not only species that attack tobacco, but also parasites and predators.

Duerden (J. C.). **The Storage of Groundnuts under tropical Conditions. II. The Effects of Storage in Paper Sacks.**—*J. Sci. Fd Agric.* **9** no. 8 pp. 483–487, 1 ref. London, 1958.

In northern Nigeria, the custom of storing groundnuts in hessian sacks with a relatively open weave results in considerable infestation by *Tribolium castaneum* (Hbst.) and sporadic attack by *Trogoderma granarium* Everts, and an account is given in this further paper of a series [*cf. R.A.E.*, A **46** 273] of tests of the effectiveness of multi-walled paper sacks in protecting shelled groundnuts from attack.

When kept under starvation conditions and separated from groundnuts by a layer of six-ply paper, adults of *Tribolium castaneum* and larvae of *Trogoderma granarium* failed to penetrate it, and field tests were therefore made with sacks of groundnuts stored in the dry season in the usual pyramidal stacks, which were protected by tarpaulins during the rains. Examination after about ten months showed that six-ply paper sacks protected uninfested groundnuts and reduced losses to a greater extent than did the normal hessian sacks, whereas previously infested groundnuts in paper sacks showed lower quality and greater losses in weight than did similar ones in hessian sacks. When closed by tying with string, paper sacks with a sleeve valve for filling afforded more protection than open-mouthed paper sacks, and both were particularly effective when situated in the upper layers or interior of a stack.

Baldit (G. L.). **Amiton—a new Acaricide and Scalicide.**—*J. Sci. Fd Agric.* **9** no. 8 pp. 516–524, 2 graphs, 7 refs. London, 1958.

Amiton (O,O-diethyl S-2-(diethylamino)ethyl phosphorothioate), which has been found to be an effective acaricide [*cf. R.A.E.*, A **44** 133], is only sparingly soluble in water and has a vapour pressure about equal to that of parathion, but its hydrogen-oxalate and toluene-p-sulphonate salts are very soluble in water and have negligible vapour pressures, so that they are very suitable for use in crop protection. The author describes the preparation of amiton, lists and discusses the physical and chemical properties of it and the two salts, and records the results of field tests in many parts of the world with amiton oxalate.

In Britain, amiton oxalate at 10 parts per million killed *Panonychus* (*Metatetranychus*) *ulmi* (Koch) but left insects and predators unharmed in preliminary tests. In more extensive investigations, 2 oz. of the salt per acre, applied in either dilute or concentrated sprays to apple at the fruitlet stage, gave complete control of this mite until after harvest and showed promise of satisfactory control through the next season, being more effective than 9 lb. 50 per cent. chlorfenson (p-chlorophenyl p-chlorobenzenesulphonate) or 6 lb. 20 per cent. chlorbenside (p-chlorobenzyl p-chlorophenyl sulphide) in 300–350 gal. spray per acre and also more effective than 20 oz. methyl-demeton [dimethyl 2-(ethylthio)ethyl phosphorothioate] in 50 gal. Amiton oxalate also gave excellent control of *P. ulmi* on apple in New Jersey [*cf.* **47** 135] at 2 oz. per 100 U.S. gal. in high-volume sprays and of *Tetranychus telarius* (L.) and *Bryobia praetiosa* Koch on pear and apple, respectively, in South Africa at 0·32 oz. per 100 gal., and proved effective against these and other fruit-tree mites in France and Italy [*cf.* **45** 3, etc.]. Tests on cotton in the United States showed that it eradicated all mites in 24 hours at 2·5–5 oz. per acre, prevented serious reinfestation for at least six weeks and, when applied at high concentrations from the air, controlled *Psallus seriatus* (Reut.), *Anthonomus grandis* Boh., *Acontia dacia* Druce, *Aphis gossypii* Glov. and *Lygus*. On *Citrus*, it controlled *Eutetranychus banksi* (McG.) (*Anychus clarki* McG.) in Texas and *Phyllocoptruta oleivora* (Ashm.) in Texas and Cyprus, and numerous Coccids, including *Aonidiella aurantii* (Mask.), *Parlatoria pergandii* Comst. and *Lepidosaphes gloverii* (Pack.) in Texas and *Coccus hesperidum* L. in South Africa; the mites were controlled with high-volume sprays containing 40 p.p.m. and low-volume sprays containing 400 p.p.m. amiton oxalate, and the Coccids by high-volume sprays of 150 p.p.m. on large trees and low-volume applications of 400 p.p.m. on small ones.

Investigations on the behaviour of $^{32}$P-labelled amiton and its salts in plants [*cf.* **46** 182] showed that amiton oxalate penetrates the cuticle and is translocated readily through the plant in solutions of pH 7·5 or more but not in acid solutions, probably because dissociation of the salt does not occur in these. Acaricidal concentrations have little effect on insect predators, probably because the oxalate has no fumigant action and only low contact action; the free amine that is slowly formed in solution has both, but readily passes through the plant cuticle and affects only the plant feeders. Detailed laboratory tests in California showed that amiton oxalate at five times the acaricidal concentration had no effect on *Hippodamia quinquesignata ambigua* Lec. and killed less than 50 per cent. of *Stethorus picipes* Csy., but it was slightly more harmful to *Aphycus* (*Metaphycus*) *luteolus* Timb. and *Orius insidiosus* (Say).

Limited tests indicated that although amiton and its salts are very toxic to mammals, there is no greater danger in handling the solid amiton oxalate in the field than in using the established organic phosphate insecticides, and the precautions advised for parathion should be followed. At 2 oz. per acre, amiton oxalate left residues of about 0·04 p.p.m. 2·5–3 months later on apples in several countries; at 60 oz. per acre, it left residues of less than 0·012 p.p.m. on *Citrus* after 90 days in the United States and Italy; and at 2–5·5 oz. per acre, applied to cotton in Texas in 2–25 U.S. gal. spray 1–2 months before the bolls opened, it left maximum residues of 0·075, 0·02 and 0·003 p.p.m. in linters, raw oil and cake after ginning, 75 per cent. of the salt in the cake and over 90 per cent. of that in the oil being subsequently destroyed by the normal refining processes.

BENNETT (F. D.) & BROWN (S. W.). **Life History and Sex Determination in the Diaspine Scale,** *Pseudaulacaspis pentagona* **(Targ.) (Coccoidea).**—*Canad. Ent.* **90** no. 6 pp. 317–324, 1 fig., 21 refs. Ottawa, 1958.

The bionomics of *Pseudaulacaspis pentagona* (Targ.) are reviewed from the literature and from field and laboratory observations in Trinidad, where this Coccid has been extensively cultured for the mass rearing of parasites and predators [*cf. R.A.E.*, A **46** 268]. In Trinidad and Bermuda, the life-cycle occupied 36–40 days in summer or at a constant temperature of 25°C. [77°F.]. The oviposition period lasts 8–9 days, and the eggs hatch in 3–4 days. The crawlers settle and feed within 48 hours of hatching, the first nymphal stage is completed in 7–8 days, and both sexes become adult 19–20 days after hatching. The males survive for 24 hours and sometimes mate with several females. The eggs are fertilised while still in the follicles, and oviposition begins 14–16 days after mating; females prevented from mating until 20 days after emergence began oviposition 9–11 days after pairing and gave rise predominantly to male offspring [*cf.* **26** 106]. Unmated females, which form an additional protective covering differing in colour and texture from that of typical females [*cf.* **36** 342], do not reproduce. Mated females produced all their female progeny first and then all their male. The eggs and first-instar nymphs show a sex difference in colour, the females being coral and the males pinkish-white [*cf.* **45** 296]. Both sexes arise from fertilised eggs, but the paternal chromosomes are eliminated at late cleavage in some eggs, and these give rise to males. In mass cultures, trays of potato tubers with almost exclusively female or male populations can be obtained by infesting them with crawlers removed, respectively, during the first or last 2–3 days of crawler production. In the field, infestation usually begins at the base of the plant, but, since female crawlers are more active than male, though both are positively phototropic, at a later stage the males are usually clustered immediately above the base whereas the females are scattered higher up the stem.

HARRIS (C. R.), BEGG (J. A.) & MAZUREK (J. H.). **A Laboratory Method of Mass Rearing of the Black Cutworm,** *Agrotis ypsilon* **(Rott.), for Insecticide Tests.**—*Canad. Ent.* **90** no. 6 pp. 328–331, 2 figs., 10 refs. Ottawa, 1958.

*Agrotis ypsilon* (Hfn.) is difficult to rear in the laboratory because of the cannibalistic habits of the larvae. Since it is an important pest in south-western Ontario, however, a technique by which it can be reared in large numbers for biological and other studies is described.

A stock of pupae capable of supplying 100 moths per week is maintained, and the emerging adults are anaesthetised with carbon dioxide and stored at 35°F. and 70 per cent. relative humidity, which they can withstand unharmed for at least 14 days. For pairing, they are transferred to cages, 12 × 12 × 16 in., with sliding glass panels in the sides; the lower part of three of the sides is of plastic gauze so that the panels can be raised for ventilation. Food is provided daily by means of dental plugs soaked in a solution of 10 per cent. dextrose, and folded and moistened paper towelling provides cover and maintains adequate humidity. Batches of 20 adults are kept in each cage at about 80°F. for four days and are then transferred to gallon glass jars covered with perforated paper and containing a layer of moistened filter paper to maintain moisture, folded moistened paper towelling for oviposition and cotton plugs soaked in 10 per cent. sugar solution. The eggs, which are laid over some ten days, with a peak between the sixth and eighth, are collected daily and incubated in petri dishes at 80°F. for three days, after which they can be stored at 35°F. and 70 per cent. relative humidity for up to 15 days. Subsequent rearing takes place at 80°F., which is the optimum for both larvae and pupae, and red clover [*Trifolium pratense*] is provided as food for the larvae. Eggs laid over a five-day period, which produce about 1,000 larvae, are distributed in six petri dishes, 14 cm. in diameter, containing moist filter paper. The larvae hatch within 24 hours and are transferred after three days to trays, 12 × 8 × 2 in., half filled with slightly moistened sand and covered with glass plates. After seven days, the sand is again moistened to enable the larvae to enter it; the clover and the larvae that have passed the third instar are removed, and the remaining larvae provided with fresh clover and tobacco. On the eighth and ninth days, larvae in the early fourth instar can be removed for tests.

To obtain a stock of 100 moths for further rearing, about 200 larvae are reared from the ninth day in four trays until they reach the fifth instar and then individually in flint jars containing a layer, 1½ in. deep, of equal parts of sand, sandy loam and vermiculite to which 5–7½ per cent. (v/v) moisture is added. Larvae in the fifth and sixth instars were fed on Beck's diet [*R.A.E.*, A **39** 440]. Cannibalism, disease and desiccation in the pupal stage cause 40–50 per cent. mortality; disease is least prevalent where the moisture content of the soil is kept low and the temperature does not exceed 80°F. At that temperature, the pupal stage lasted 14 days. Rearing was continued for ten generations without loss of vigour or tolerance to insecticides. To maintain a culture yielding 1,000 larvae per week, a cage of 20 adults must be set up every second day.

IVES (W. G. H.) & PRENTICE (R. M.). **A Sequential Sampling Technique for Surveys of the Larch Sawfly.**—*Canad. Ent.* **90** no. 6 pp. 331–338, 4 figs., 9 refs. Ottawa, 1958.

The method of assessing egg populations of *Pristiphora erichsonii* (Htg.) on larch, developed for intensive population studies in Canada [*R.A.E.*, A **45** 179], is unsuitable for surveys of widespread infestation, because of the large samples required, and a sequential sampling plan [*cf.* **44** 159] was accordingly developed. Current shoots in which eggs have been laid are usually obvious, because the injury sustained causes them to curl, to an extent dependent on their developmental stage; if their growth is complete, they do not curl, but the oviposition scars are readily visible. The average number of eggs laid per shoot varies, but not sufficiently to affect the broad infestation classes defined for this type of survey. The proportion of shoots containing eggs is therefore considered a satisfactory basis for an index of population density.

Intensive egg sampling carried out at three different crown levels in several plots in Manitoba on two-branch samples in 1952 and on whole trees in 1953 showed that there was considerable variation in the proportion of infested shoots between crown levels, plots and years, but that the proportion in the mid-crown was fairly representative, so that this level can be taken as a suitable sampling universe. Further sampling indicated that the shoots are attacked at random on a branch. When the proportions of shoots with oviposition scars found on 20 whole-branch samples per plot, cut from trees in widely distributed permanent sample plots with various infestation histories, were correlated with the estimated percentages of defoliation, classified as light (less than 20), moderate (30–60) and severe (over 70), in each plot when larval feeding was complete, the proportions associated with the three classes were found to be less than 0·08, 0·12–0·22 and over 0·28, respectively.

Sampling, which can be carried out at any time after oviposition is complete, usually about mid-August, involves the examination in groups of ten, from the tip downwards, of the current shoots on two whole branches from the mid-crown of trees selected at random in each plot and the recording, after examination of each group, on graphs or in tables of the cumulative numbers of shoots with oviposition scars; where the number of shoots on a branch is not a multiple of ten, the remaining ones are carried over to the next branch. The limits in the cumulative numbers that indicate infestation intensities intermediate between the two lower and the two higher infestation classes and hence the need for further sampling, are shown on a graph and in a table, and counting is continued until the cumulative number falls into the zone characteristic of one of the infestation classes. An operating characteristic curve shows that the probability of classifying a light infestation as severe or a severe one as light is negligible. Average sample number curves indicate that the largest samples are required for intermediate infestation intensities, and the need to examine more than 400 shoots is stated to be unlikely.

The method was used to classify infestations in 48 permanent sample plots in the autumn of 1956, when only light and moderate infestations were encountered and the sampling time per plot varied from one to three hours. The ratings obtained agreed with defoliation ratings in all but two cases. Local adjustments in the infestation limits may be necessary to compensate for any marked changes in the numerical relation between shoots and foliage that may occur in response to defoliation.

Finnegan (R. J.). **The Pine Weevil,** *Pissodes approximatus* **Hopk., in southern Ontario.**—*Canad. Ent.* **90** no. 6 pp. 348–354, 2 figs., 12 refs. Ottawa, 1958.

*Pissodes approximatus* Hopk., all stages of which are described, has in recent years increased markedly in southern Ontario, especially where pure stands of pine, notably Scots pine (*Pinus sylvestris*), are grown for the Christmas-tree market, and in several areas where large populations have built up in stumps of the previous year's cutting, standing trees have been killed or their value reduced by heavy adult feeding on the twigs and small branches. Observations on the bionomics of the weevil were made in 1955–56 in several widely separated pine plantations, in nursery seedling beds and in the laboratory, where the weevil was reared by making small grooves on the cambial surface of fresh pine bark, inserting newly hatched larvae and holding the bark firmly against the bottom of a petri dish by filling the dish with sand and exerting pressure on the cover by means of rubber bands.

The winter is passed mostly in the adult stage in duff and top soil over the roots of the trees and under scales and in crevices of the bark, but some larvae and pupae overwinter within the tree, and these give rise to adults that emerge in late June and July and again overwinter. The overwintered adults become active in early May and feed for about three weeks on the inner bark of pine branches, especially low ones in contact with the litter, and the stems of seedlings and small trees. In feeding, the adult makes a puncture in the outer bark through which it inserts its rostrum and chews a larger area of the inner bark. The outer bark eventually flakes off, and the damage is then seen to resemble that due to *Hylobius pales* (Hbst.)

and *H. radicis* Buch., which are sometimes associated with *Pissodes approximatus* on young pines and chew both outer and inner bark. Mass flights of *P. approximatus* to suitable breeding sites occur in the latter part of May. In 1956, the first egg was found in the field on 26th May and in the laboratory on 13th June. Most females completed oviposition and died before the second week of July, but a few continued to lay eggs until early September. Breeding normally takes place in the inner bark of unhealthy or dying pines. Newly transplanted ones are very attractive, and trees of all ages and all parts of the trees except branches less than ½ in. in diameter are attacked. Of 40 nine-year-old Scots pines transplanted in October 1955, five were heavily infested by the following June and dead before the end of July; larval populations in the lower 2 ft. of the trunks averaged 224 per sq. ft. of bark. In seedlings with bark too thin to accommodate the mature larvae, larvae bore to the centre of the stem and pupate there, and damage of this type was very noticeable in 1956 in seedlings of Austrian pine (*Pinus nigra*) in one nursery, where about 9 per cent. died in consequence. Eggs may be laid anywhere on the trunk or large branches, but the rough bark at the nodes is preferred. The females lay an average of 47 eggs each, singly or sometimes in groups of 4–5, in pockets chewed in the inner bark. Of 521 laid in the laboratory, only 11 failed to develop.

The larvae hatch in about eight days and mine in the cambial layer along the grain of the wood. They pass through four instars, of which the last occupies 24 days, and become full-fed in 36 days. Pupation takes place in a chamber constructed in the outer surface of the wood, and the pupal stage lasts about two weeks. Complete development averaged 59·8 days in 1956. The adults remain in the pupal chamber for about five days. In outdoor cages, emergence began on 26th July in 1956 and was heavy between 15th August and 10th September. The sex ratio was approximately 1:1. The adults feed until the onset of cold weather, but mating and oviposition do not occur until the following year. An average of 216 adults developed per sq. ft. in logs infested in June 1956, but only 51 in logs infested in early September. The relative percentage of each stage overwintering depends largely on the season at which breeding material becomes available. Large populations are usually associated with Christmas-tree cuttings in autumn. The stumps are attacked in late May and early June of the following year, and there is a large emergence of adults in August and September. Breeding material later in the summer is relatively limited, and there are consequently few overwintering larvae and pupae.

*Pissodes approximatus* cannot successfully attack healthy trees, and numbers are normally checked by the limited supplies of breeding material, but large populations develop where pines are grown in pure stands and stumps are left to rot after felling. An ectoparasite of the genus *Coeliodes* destroyed up to 35 per cent. of the larvae in 1956, and birds also afford some control. In 1956, woodpeckers destroyed up to 90 per cent. of the population in individual trees by completely stripping the bark from the stems and large branches. Weevils in stumps were rarely attacked by birds, but are subjected to severe competition from other Coleoptera.

BLAIS (J. R.). **Effects of 1956 Spring and Summer Temperatures on Spruce Budworm Populations** (*Choristoneura fumiferana* **Clem.**) **in the Gaspé Peninsula.**—*Canad. Ent.* **90** no. 6 pp. 354–361, 1 map, 8 refs. Ottawa, 1958.

The following is almost entirely the author's summary. In 1956, all stands of coniferous forest in the Lower St. Lawrence and Gaspé regions of eastern

Canada were infested by *Choristoneura fumiferana* (Clem.), and repeated defoliation had caused considerable damage in many areas; still more widespread mortality might have occurred had extensive aerial spraying not been carried out since 1954. Temperatures in May–August 1956 were much cooler than normal throughout the region, and insect development was consequently greatly retarded. In some districts there was a shortage of current year's foliage on balsam fir [*Abies balsamea*], black spruce [*Picea mariana*] and white spruce [*P. glauca*], and as the larvae were forced to feed on old needles, their development was still further retarded [*cf. R.A.E.*, A **40** 303]. At higher elevations, in the Shickshock Mountains, development was so delayed that some pupae failed to give rise to adults and a considerable number of eggs failed to hatch before the onset of the cold autumn weather. The same conditions apparently also killed many first-instar larvae. As a result, populations were very low in this district in 1957. Elsewhere in the Gaspé peninsula, populations were high, and there is no reason to believe that the outbreak is nearing its end.

Chapman (J. A.) & Kinghorn (J. M.). **Studies of Flight and Attack Activity of the Ambrosia Beetle,** *Trypodendron lineatum* **(Oliv.), and other Scolytids.**—*Canad. Ent.* **90** no. 6 pp. 362–372, 5 figs., 13 refs. Ottawa, 1958.

The following is based largely on the authors' summary. Seasonal activity of *Trypodendron lineatum* (Ol.) [*cf. R.A.E.*, A **47** 129] was studied in relation to site and weather in a forest area near Cowichan Lake, British Columbia, in 1954–56. It was found that heavy spring flights of adults can be expected when the air temperature exceeds 60°F. after most of the snow has melted. Intense early warm periods may cause flight activity to begin simultaneously over a wide range of altitudes, but if warming is gradual or if some snow remains after the air is warm enough for flight, flights may occur over a period of several weeks at different altitudes. Flights of *T. lineatum* are preceded in spring by the appearance of *Pseudohylesinus nebulosus* (Lec.). Many other Scolytids may also fly during these warm periods, but they do not usually appear so early in the season. At least one further period of attack can be expected after the first brood has developed. Flight activity is most noticeable near attractive logs, and these, therefore, should be present in a study area throughout a season if a valid picture of flight periods is to be obtained. Most flight activity near felled logs takes place near ground level. The flight from brood logs to overwintering quarters is relatively inconspicuous and occurs over a period of several weeks.

Several collecting methods were used, and it is concluded that glass-barrier traps [*cf.* **45** 7] provide representative and useful samples, although their effectiveness is influenced by many factors, including speed and direction of wind and of flight, manner of flight and amount of reflection from the glass. Barrier traps of painted hardboard proved less effective for most Scolytids. Ultraviolet light, but not light from an incandescent source, appeared to be attractive to *T. lineatum*. The use of cloth collecting trays beneath logs sprayed with lindane [$\gamma$ BHC] gave a good indication of flight activity of beetles attracted to the logs, but coloured pans [*cf.* **46** 202] were of little value. Many beetles leaving their brood galleries were taken in pans containing oil and water placed beneath infested logs, which could thus be used for determining periods of emergence from the logs. Waxed cardboard containers in which portions of infested logs were enclosed and with glass vials for the collection of emerging beetles inserted in their walls were also useful for this pupose.

McClanahan (R. J.) & Miller (L. A.). **Laboratory Rearing of the Seed-corn Maggot,** *Hylemya cilicrura* **(Rond.) (Diptera: Anthomyiidae).**—*Canad. Ent.* **90** no. 6 pp. 372–374, 1 fig., 5 refs. Ottawa, 1958.

A method is described whereby *Hylemyia cilicrura* (Rond.) was reared in the laboratory over a period of two years. Puparia obtained from baits of wheat flour were stored at 40°F. and 70 per cent. relative humidity until adults were required, when they were transferred to cages, 10 × 24 × 10 in., which were covered with clear plastic film and kept at 65–75°F. Food was supplied in units consisting of a wire frame supporting four cotton wicks, of which one dipped into distilled water, another dipped into a solution of 10 per cent. egg white and 1 per cent. sucrose, the third had been soaked in a 5 per cent. yeast suspension, and the fourth had been soaked in a mixture of molasses, evaporated milk and water (1:1:2). Adults were transferred to oviposition units by means of an aspirator inserted through a cotton sleeve. These consisted of wide-mouthed gallon jars, 6 in. in diameter, having the bottoms removed and the tops covered with cheesecloth, standing in 9-in. flower-pot saucers (with a hole in the middle), containing sifted muck soil with a moisture content of 25 per cent. in which 20 peas, previously soaked, had been set to provide food for the larvae; a feeding unit was provided in each jar for the adults. The oviposition units stood in a metal tray, to which water was periodically added to keep the soil moist. The temperature in the jars, which were protected from direct sunlight and illuminated artificially from 5 to 10 p.m., was a little above 65°F. The number of adults in each jar was maintained at 50, and the saucers and feeding units were changed every 3–5 days. A further layer of moist soil, ½ in. deep, was added to each saucer after removal, and additional soaked peas to those in which oviposition had been heavy, and the saucers were then kept at 80°F. and 80–85 per cent. relative humidity for ten days, after which the soil was sifted and the puparia placed in small dishes of soil in the emergence cages.

Under these conditions, the females began to oviposit after 10–20 days and continued throughout life. The average survival period of the adults was four weeks, with a maximum of six. The egg stage lasted three days at 65°F., the larval stage 8–10 days at 80°F., and the pupal stage 4–6 days at 68–72°F. Mortality among eggs and first-instar larvae amounted to 60 per cent., and over-all mortality to 70 per cent.

Baldwin (W. F.), Riordan (D. F.) & Smith (R. W.). **Note on Dispersal of Radio-active Grasshoppers.**—*Canad. Ent.* **90** no. 6 pp. 374–376, 1 ref. Ottawa, 1958.

Nymphs and adults of *Camnula pellucida* (Scudd.) were previously found to disperse for up to 240 yards in six days when released on bare, cultivated fields but to be unable to orientate themselves towards a food-supply [*R.A.E.*, A **44** 110]. In further tests, the dispersal of *Melanoplus bilituratus* (Wlk.) (*mexicanus*, auct.) released in a field already containing grasshoppers, mostly *M. bilituratus*, and an adequate food-supply was investigated in Ontario. Preliminary tests in 1952 showed that the grasshoppers could be satisfactorily tagged with radioactive phosphorus ($^{32}$P) by feeding them for one day on a mash prepared from 1 lb. bran, 50 ml. molasses and 2 millicuries $^{32}$P as orthophosphoric acid, and moistened with water, and then on fresh grass for a further 24 hours, during which the excess $^{32}$P was excreted; subsequent contamination of the testing ground was thus avoided. In 1953, 8,000 tagged nymphs in the third and fourth instars and 7,500 tagged adults were released at the centre of a field of lucerne, timothy grass [*Phleum* *pratense*] and weeds on 8th July and 13th August, respectively, and samples were subsequently taken in each of four 15° sectors extending north, south, east and west from the centre, at distances of 10, 20, 30 and 40 yards from it, by throwing a cage, 1 sq. yard in area, on to the ground in front of the operator; the number of samples taken at each distance was increased from two at ten to eight at 40 yards, and the grasshoppers were released after being tested for radioactivity. Most radioactive nymphs or adults were caught within 20 yards of the release point, and none at 40 yards of it. In observations over 20 days, 43 per cent. of the nymphs taken were at a distance of 10 yards from the centre and only 18 per cent. at 30 yards, and the corresponding percentages for the adults over 18 days were 56 and 9. Despite the large numbers released and although the centre of the field was somewhat denuded when the adults were liberated, a sample taken there after 12 days contained 13 radioactive adults.

Read (D. C.). **Notes on** *Scatophaga stercoraria* **(L.) (Diptera: Anthomyiidae), a Predator of the Cabbage Maggot,** *Hylemya brassicae* **(Bouché).**—*Canad. Ent.* **90** no. 6 p. 376, 2 refs. Ottawa, 1958.

*Scatophaga stercoraria* (L.), which was observed preying on adults of *Hylemyia brassicae* (Bch.) in an outdoor cage in Prince Edward Island in 1956, was captured in 1957 in fields of swedes throughout Prince Edward Island and north-eastern Nova Scotia, and was often more abundant than *H. brassicae* itself. It had not previously been recorded feeding on adults of this Anthomyiid in Canada. It also attacked *Coenosia tigrina* (F.) under cage conditions, one individual destroying as many as three adults in a day. Females were more voracious than males.

Warren (G. L.). **A Method of rearing Bark- and Cambium-feeding Beetles with particular Reference to** *Hylobius warreni* **Wood (Coleoptera: Curculionidae).**—*Canad. Ent.* **90** no. 7 pp. 425–428, 2 figs., 7 refs. Ottawa, 1958.

A technique for rearing *Hylobius warreni* Wood, a recently described weevil that was formerly confused with *H.* (*Hypomolyx*) *piceus* (Deg.) and of which the larvae attack the inner bark and cambium of the root system of jack pine (*Pinus banksiana*) and other conifers in Canada, was developed in the course of studies on its bionomics. A bark homogenate prepared by adding granulated agar to bark stripped from the roots of living trees and minced with a little water, heating to 80°F., and removing the surplus moisture with unglazed paper, proved unsatisfactory as a medium for incubating the eggs, which failed to hatch on it, or rearing the larvae, which fed on it readily but became embedded in it, but was useful as a pupation medium and for transporting field-collected larvae to the laboratory. The eggs were incubated on moist cotton, but it was necessary to transfer the newly hatched larvae to a food medium within a day to avoid heavy mortality. The larvae were successfully reared in rings of outer and inner bark with some cambium attached, cut from roots or root collars of living trees, with the central hole just large enough to accommodate the larva and the outer bark shaved to a suitable thickness, each surrounded by a strip of moistened dental cotton and held between two glass plates by adhesive tape. Food was renewed as required, and the cotton moistened by dipping the vertically held chamber in distilled water when necessary. Larvae in the chambers were completely visible or easily found and removed for examination, they resumed feeding when the food was renewed, and there was little mortality. Late last-instar larvae were transferred to the homogenate for pupation, because the pupal cells are constructed before the larvae cease feeding, when they are indistinguishable from prepupae, and disturbance at that time, as for renewal of food, resulted in incomplete cells and high pupal mortality.

HERBERT (H. J.). **A new Species of** *Typhlodromus* **Scheuten, 1857 (Acarina: Phytoseiidae), with Notes on Life-histories and Food Habits of** *Typhlodromus* **sp. n. and** *T. tiliae* **Oudms.**—*Canad. Ent.* **90** no. 7 pp. 429–433, 4 figs., 2 refs. Ottawa, 1958.

A predacious mite found on the bark of apple trees in Nova Scotia is described from adults of both sexes as *Typhlodromus corticis*, sp. n. It resembles *T. tiliae* Oudm., and an account of laboratory studies on the bionomics and food habits of the two mites is given [*cf.* also *R.A.E.*, A **46** 267], together with characters differentiating them. The mites were reared individually in capsules at a temperature of about 70°F. *T. tiliae* developed and laid eggs when fed on larvae of *Bryobia praetiosa* Koch or eggs of *B. praetiosa*, *Panonychus* (*Metatetranychus*) *ulmi* (Koch) or *Tetranychus telarius* (L.), and *Typhlodromus corticis* did so when fed on larvae of *B. praetiosa* or eggs of *P. ulmi*. Protonymphs of *T. corticis* that were fed only on eggs of *Tetranychus telarius* did not reach the deutonymphal stage, but when larvae of *B. praetiosa* were also provided, their development was similar to those fed solely on these larvae. The larval stage, in which the mites fed little if at all, lasted about one day in each species The combined protonymphal and deutonymphal stages of *Typhlodromus tiliae* fed on larvae of *B. praetiosa* and on eggs of this mite, *Tetranychus telarius* and *P. ulmi* lasted 6·9, 12·4, 10 and 8·3 days, respectively. The total survival period, from hatching to death, of the females was longer when they were fed on larvae of *B. praetiosa* (144 days) than on eggs of *T. telarius* (95), but that of the males was similar on the two diets (44 and 59 days); the average numbers of larvae and (in brackets) of eggs consumed were 264 (833) for the males and 853 (1,550) for the females. The protonymphal and deutonymphal stages of *Typhlodromus corticis* fed on larvae of *B. praetiosa* lasted 7·7 and 6 days, respectively, the total survival period was 98 days for males and 91 for females, and the number of larvae consumed by the two sexes averaged 435 and 480, respectively. When reared on larvae of *B. praetiosa* and fed in the adult stage on eggs of *Tetranychus telarius*, males survived for an average of 31 days and consumed averages of 79 larvae and 181 eggs, and the corresponding figures for the females were 41, 110 and 231; six females that appeared almost dead and were supplied with larvae of *B. praetiosa* survived for an average of 135 days and consumed averages of 500 larvae and 356 eggs. Males and females reared and fed as adults on eggs of *P. ulmi* survived for total periods of only 34 and 52 days, during which they consumed 108 and 190 eggs. Mating took place soon after the adult stage was reached in both species. It was not observed when males of each species were confined with females of the other, and the females did not oviposit until they had paired with a male of their own species. Eggs were laid singly at irregular intervals, and the duration of the incubation period averaged 4·3 days for *Typhlodromus tiliae* and 3·2 for *T. corticis*. Eggs of *T. corticis* appeared to contain fully formed larvae while still within the female. Females of both *T. corticis* and *T. tiliae* laid most eggs (averaging 17·8 and 29·3, respectively) when fed on larvae of *B. praetiosa*. The percentage of females among the total number of mites reared was 61 in *T. tiliae* and 63 in *T. corticis*. The proportion was highest in *T. tiliae* when fed on larvae of *B. praetiosa* or eggs of *Tetranychus telarius* (84–85 per cent.) and in *Typhlodromus corticis* when fed on larvae of *B. praetiosa* alone or with eggs of *Tetranychus telarius* (64–65 per cent.).

SWAILES (G. E.). **Periods of Flight and Oviposition of the Cabbage Maggot,** *Hylemya brassicae* **(Bouché) (Diptera: Anthomyiidae), in southern Alberta.**—*Canad. Ent.* **90** no. 7 pp. 434–435, 1 ref. Ottawa, 1958.

Infestation by *Hylemyia brassicae* (Bch.) is one of the chief factors limiting the production of high-quality swedes in the irrigated districts of southern Alberta. Since damage to the crop occurs late in the growing season, the flight and oviposition periods of the Anthomyiid were investigated with a view to the possibility of avoiding infestation by a change in cropping practice. It was found that two generations develop each year. Adults first emerged from overwintered pupae on 18th, 21st and 8th May in 1955, 1956 and 1957, respectively; most emerged between mid-May and mid-June. First-generation adults emerged in late August and produced a maximum number of eggs in early September. The average number of second-generation eggs per plant ranged from 321 in 1953 to 507 in 1956, whereas the average number of first-generation eggs per plant in 1956 was 321. Most of the damage to swedes is caused by the second-generation larvae. Swedes are usually sown between late April and late May, and peak oviposition by females of the overwintered generation, in the first week of June, coincides with the appearance of the seedlings above ground. Observations showed that small plants, with 6–8 leaves or even more, are unattractive to the ovipositing females, and by delaying sowing until late May, so that the plants are not in a susceptible stage at the period of peak oviposition, the number of first-generation adults in August and September should be reduced.

HARPER (A. M.). **Notes on Behaviour of** *Pemphigus betae* **Doane (Homoptera: Aphididae) infected with** *Entomophthora aphidis* **Hoffm.**—*Canad. Ent.* **90** no. 7 pp. 439–440, 1 fig., 3 refs. Ottawa, 1958.

*Pemphigus betae* Doane normally remains below ground on the roots of sugar-beet in summer and autumn, but in September 1956 large numbers were found on the soil and on the crowns and leaves of plants in many fields in southern Alberta; many of the aphids remained clinging to the leaves even when dead. The organism that destroyed them was identified as *Entomophthora aphidis*, which had been reported attacking root aphids only in Colorado [*cf. R.A.E.*, A **5** 17–18] and California and had previously been recorded in Canada infesting *Macrosiphum* (*Acyrthosiphon*) *pisum* (Harris) in Nova Scotia [**45** 403]. The disease was of negligible importance in 1957, and since all sugar-beet in Alberta is grown on irrigated land and moisture favours the development of fungi, its establishment might be facilitated by modification of the irrigation methods employed.

BESS (H. A.). **The Green Scale,** *Coccus viridis* **(Green) (Homoptera: Coccidae), and Ants.**—*Proc. Hawaii. ent. Soc.* **16** no. 3 pp. 349–355, 4 refs. Honolulu, 1958.

Investigations on the effect of attendance by ants on *Coccus viridis* (Green) and some other honeydew-producing insects were begun in Ceylon in 1954. A natural infestation on a large coffee tree, attended by a vigorous colony of *Oecophylla smaragdina* (F.) and an artificial infestation on orange plants grown in pots, attended by *Technomyrmex detorquens* (Wlk.) (*albipes* (F. Sm.)) were used, and ants were excluded from certain branches of the coffee tree from 4th September and from some of the orange plants from 1st

October. Examination of leaf samples about once a fortnight showed that the scale declined rapidly in the first few weeks and disappeared completely within about four months in the absence of ants; the colonies were still thriving in March 1955, at the end of the experiment, when ants were present. The accumulation of honeydew on the scales and foliage began within a few hours of the exclusion of ants and was followed by abundant growth of sooty mould, which appeared to interfere with the settling of crawlers and covered many of the adults. No ants were seen to attack or transport a living scale, but several carried wax from them. There was no evidence that ants reduced attack by parasites, mainly *Aneristus ceroplastae* How., or predators.

FULLAWAY (D. T.). **Importations of natural Enemies of the Weed,** *Emex spinosa* **Campd.**—*Proc. Hawaii. ent. Soc.* **16** no. 3 pp. 359–360. Honolulu, 1958.

The harmful weed, *Emex spinosa*, is believed to have been introduced into Hawaii with grass seed from Australia many years ago, and attempts to control it were begun about 1940, when it was suppressing large areas of pasture. The methods tested included the introduction of insect enemies, of which *Apion antiquum* Gylh., found boring as larvae in the stems of the very closely related species, *E. australis*, in South Africa, was introduced in January–March 1957, reared and liberated in different islands. Experiments showed that this weevil killed all stems to the ground and passed through a generation in about a month, but it was not known how it would survive the dry season, when the weed is more or less dormant. Other insects tested were not specific to *E. spinosa* or failed to survive; *A. marchicum* Hbst. (*violaceum* Gylh.), found in *Emex* stems in Morocco, was recently sent to Hawaii and is being tested for specificity.

TANADA (Y.) & BEARDSLEY jr. (J. W.). **A biological Study of the Lawn Armyworm,** *Spodoptera mauritia* **(Boisduval), in Hawaii (Lepidoptera: Phalaenidae).**—*Proc. Hawaii. ent. Soc.* **16** no. 3 pp. 411–436, 7 figs., 38 refs. Honolulu, 1958.

The following is based largely on the authors' summary. *Spodoptera mauritia* (Boisd.) appeared in Hawaii in 1953 and rapidly became a pest of lawns, particularly those of *Cynodon dactylon* [*cf. R.A.E.*, A **46** 173]. All stages of this Noctuid are described, and laboratory and field observations on its bionomics are recorded. The life-cycle from egg to adult lasted about 42 days in the laboratory, and females that had been caged with males during the first night after emergence laid an average of 8·6 egg-masses. The number of eggs averaged 709 per mass, and the egg, larval and pupal stages lasted about 3, 28 and 11 days, respectively. Adult males lived for an average of 10·3 and females for 10·6 days. Starvation and food-preference tests indicated that the larvae feed mainly on grasses and sedges; they selected tender rather than tough foliage and, when forced to feed only on the latter, took longer to complete their development. In the field, most of the eggs were deposited on the foliage of shrubs and trees or on the eaves and walls of buildings; very few were laid on the leaves of the grasses that serve as food for the larvae.

The natural enemies observed included a polyhedral virus [*cf. loc. cit.*]; the toad, *Bufo marinus*; a Scelionid egg-parasite, *Telenomus nawai* Ashm.; a Braconid parasite of the young larvae, *Apanteles marginiventris* (Cress.);

and three Tachinids, *Chaetogaedia monticola* (Big.), *Achaetoneura archippivora* (Will.) and *Blondelia (Eucelatoria) armigera* (Coq.), which parasitised the larvae but did not kill them until they had completed feeding.

Koyama (T.) & Horiguchi (H.). **Studies on the Application of Insecticide to some Pests of Rice. 1. Relation of Spraying Concentration and Volume of Dieldrin in Control on the Rice Stem Maggot,** *Chlorops oryzae* **Matsumura.** [*In Japanese* ]—*Bull. Tohoku nat. agric. Exp. Sta.* no. 13 pp. 26–31, 4 graphs. Morioka, 1958. (With a Summary in English.)

The following is based on the authors' summary. In tests in Japan to determine the effect of concentration and volume of spray on the control of *Chlorops oryzae* Mats. on rice given by dieldrin, plots a quarter of an acre in extent were sprayed with 0·18, 0·35, 0·7, 1·06 or 1·41 pints 18·5 per cent. emulsion concentrate, diluted with 7·92, 15·84, 31·68 or 63·36 gal. water, when the plants were about 12 in. high. At constant concentrations, the quantity of toxicant deposited on the plants increased with the rate of spray application, but for all except the lowest quantity of concentrate, for which the results could not be determined, 15·84 gal. spray resulted in the heaviest deposit and 7·92 and 63·36 gal. in the lightest. The insecticidal effect increased with increased deposit and the number of ears damaged by *C. oryzae* was inversely proportional to the latter, but no toxicity could be detected by bioassay after seven days.

Heinze (K.). **Phytopathogene Viren und ihre Uberträger. Phytopathogenic Viruses and their Vectors.**—290 [ +1] pp., 15 pp. refs. Berlin, Duncker & Humblot, 1959. Price *DM*. 48.

This book consists of an introduction on the behaviour of plant viruses in relation to their insect or other invertebrate vectors, a list of the viruses concerned, arranged according to the families of their plant hosts, and a systematic list of the vectors (pp. 98–259), which are mostly insects, showing their synonyms and distribution, the viruses transmitted by them and the source or sources of the information. It also includes an index to the viruses and another to the vectors.

**Radio-isotopes. Pretoria 1957.**—*Publ. sci. Coun. Afr. S. Sahara* no. 28, 230 pp., refs. [London] Comm. tech. Co-op. Afr. S. Sahara, 1959.

The only paper of entomological interest read at this meeting is **Outline of the Use of Radio-isotopes at the West African Cocoa Research Institute** (pp. 89–91), by A. H. Ward, which includes a brief review of the uses to which radio-isotopes have been put in studies of the mealybugs that transmit the swollen-shoot virus disease of cacao in Ghana. In 1952, the mealybugs were placed on agar containing radioactive phosphorus ($^{32}P$), to estimate the interval before feeding began. The results indicated that the preliminary resting period was long and variable, which possibly explains the low and unequal percentages of transmission obtained when viruliferous mealybugs were artificially transferred in experiments. The results were confirmed in 1953, when mealybugs were allowed to feed on cacao seedlings with their roots in a radioactive solution. The isotopes used in this were first waste radioactive strontium ($^{90}Sr$) and then $^{32}P$. The latter was used in 1953–54 to assist in discovering the distances traversed by mealybugs dispersing from piles of slash from felled diseased cacao trees; the distances proved to be short [*cf. R.A.E.*, A **43** 80; **44** 187]. The uptake and translocation of $^{32}P$ in cacao trees was also investigated, in connection with attempts to label mealybugs in their natural habitat in the tree canopy. Application to the soil resulted in the most even distribution of radioactivity.

## PAPERS NOTICED BY TITLE ONLY.

DAVATCHI (A.) & TAGHIZADEH (F.). **Les insectes nuisibles aux aurantiacées en Iran.** [*In Persian.*]—*Ent. Phytop. appl.* no. 14 pp. *3–80*, 23 figs., 6 refs. Teheran, 1954. (With a Summary in French, pp. 1–21.) [Recd. September 1959.]

SHCHEGOLEV (V. N.). Ed. **The Entomologist's Glossary and Reference Book. Second revised and enlarged Edition.** [*In Russian.*]—9 × 5¾ in., 631 pp., text illus., many refs. Moscow, Gosud. Izd. sel'skokhoz. Lit., 1958. Price 19 *rub.* 30 *kop.* [*cf. R.A.E.*, A **44** 32.].

GUAGLIUMI (P.). **Una nueva langosta que está invadiendo las sabanas de Apure.** [A new Grasshopper, *Rhammatocerus viatorius* Sauss., invading the Savannahs of Apure, Venezuela.]—*Agron. trop.* **8** no. 1 pp. 27–31, 2 figs. Maracay, 1958. (With a Summary in English.) [*Cf. R.A.E.*, A **47** 137.]

BÄRNER (J.). **Bibliographie der Pflanzenschutzliteratur. Bibliography of Plant Protection . . . 1952.**—xli + 433 pp. Berlin, P. Parey, 1959. Price *DM.* 43. [*Cf. R.A.E.*, A **47** 40, etc.]

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